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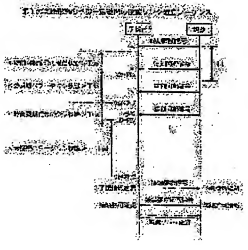
(54) STARTING METHOD AND APPARATUS FOR RADIO DATA COMMUNICATION

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce the power consumption of a slave set in an unconnected state which is not connected to a master set.
SOLUTION: A radio data communication starting method has a configuration wherein the master set transmits a time synchronization signal including time information generated by a communication timer at least one time for every predetermined cyclic time Tt; the slave set in an unconnected state alternately repeats a reception state for receiving the time synchronization signal and a non-synchronization power down state for only a predetermined time Tda, in the case where the time synchronization signal is not received during the reception state until the time synchronization signal is received; the slave set is brought into a synchronization state in which it is synchronized with the master station on the basis of the time information when receiving the time synchronization signal, and shifts to a non-connection power down state for only a predetermined time Tpd assigned to each slave set; and after that, the slave set transmits by broadcasting a connection request signal including the information of the slave set and requesting connection to the master set, receives a connection request responding signal including connection permission information transmitted from the master set in response to the connection request signal, and shifts from an unconnected state to a connected state.



3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]
With a wireless data communication system which performs wireless data transmission between at least one cordless handset and a main phone connected to a predetermined network. In a wireless-data-transmission start method that a cordless handset of a non-connected state which is not connected with a main phone establishes a radio link with a main phone, changes to a connected state, and starts wireless data transmission,
Said main phone transmits a time synchronized signal including time information which a communication timer generates once [at least] to the predetermined period time Tt,
As said non-connected state, said cordless handset has the asynchronous state which omits a time synchronization with said main phone, before receiving said time synchronized signal,
A cordless handset of said asynchronous state,
Said predetermined period time Tt A receive state for receiving said time synchronized signal to the above receiving time Tua (Tua>=Tt), An asynchronous powered down state to which only the predetermined time Tda reduces a power consumption level of a cordless handset when said time synchronized signal is not received in the meantime is repeated by turns until said time synchronized signal is received,
When said time synchronized signal is received, it will be in a synchronous state which amended a communication timer of a cordless handset based on the time information, and was synchronized with a main phone, and only the predetermined time Tpd assigned for every cordless handset changes to an unconnected powered down state to which a power consumption level of a cordless handset is reduced,
Broadcast transmission of the connection request signals which require connection with said main phone after said unconnected powered down state including information on said cordless handset is carried out, a connection-request reply signal including connection permission information transmitted from said main phone to the connection request signals is received, and it changes from said non-connected state to said connected state,
A wireless-data-transmission start method characterized by things.
[Claim 2]
In a wireless-data-transmission start method according to claim 1,
Said main phone carries out broadcast transmission of the beacon signal including information which shows a cordless handset connect time belt assigned for every cordless handset by predetermined periodic Tb controlled by said communication timer,
Instead of a cordless handset which received said time synchronized signal from said asynchronous state of said non-connected state, and changed to said synchronous state changing to said unconnected powered down state,
Only time Tpd.b until said beacon signal acquired from time information of said time synchronized signal arrives changes to a beacon powered down state to which a power consumption level of a cordless handset is reduced,
A beacon signal is received after said beacon powered down state, and it changes to a cordless handset connect time belt powered down state to which only time Tpd.a1 to a cordless handset connect time belt notified with said beacon signal reduces a power consumption level of a cordless handset,
Broadcast transmission of said connection request signals is carried out with a cordless handset connect time belt after said cordless handset connect time belt powered down state,
A wireless-data-transmission start method characterized by things.
[Claim 3]
In a wireless-data-transmission start method according to claim 2,
When a beacon signal is not received after said beacon powered down state, only time Tpd.a2

until said beacon signal of the next by which broadcast transmission is carried out by said predetermined periodic Tb is received changes to said beacon powered down state.
A wireless-data-transmission start method characterized by things.
[Claim 4]
In a wireless-data-transmission start method according to claim 2,
A cordless handset which went into a cordless handset connect time belt after said cordless handset connect time belt powered down state,
Within said cordless handset connect time belt, it changes to a connection-request powered down state to which only predetermined time Tpd.a reduces a power consumption level of a cordless handset,
It checks that other radio is not performed after said connection-request powered down state, and broadcast transmission of said connection request signals is carried out.
A wireless-data-transmission start method characterized by things.
[Claim 5]
In a wireless-data-transmission start method according to claim 2 or 4,
When a connection-request reply signal over said connection request signals is not received, only time Tpd.a2 until said beacon signal of the next by which broadcast transmission is carried out by said predetermined periodic Tb is received changes to said beacon powered down state.
A wireless-data-transmission start method characterized by things.
[Claim 6]
With a wireless data communication system which performs wireless data transmission between at least one cordless handset and a main phone connected to a predetermined network, In a wireless-data-transmission start method that a cordless handset of a non-connected state which is not connected with a main phone establishes a radio link with a main phone, changes to a connected state, and starts wireless data transmission,
Said main phone carries out broadcast transmission of the beacon signal including time information which a communication timer generates, and information which shows a cordless handset connect time belt assigned for every cordless handset by predetermined periodic Tb controlled by said communication timer,
As said non-connected state, said cordless handset has the asynchronous state which omits a time synchronization with said main phone, before receiving said time synchronized signal,
A cordless handset of said asynchronous state,
A receive state for receiving said beacon signal to said predetermined receiving time Tua and an asynchronous powered down state to which only the predetermined time Tda reduces a power consumption level of a cordless handset when said beacon signal is not received in the meantime are repeated by turns until said beacon signal is received,
When said beacon signal is received, it will be in a synchronous state which amended a communication timer of a cordless handset based on the time information, and was synchronized with a main phone, It changes to a cordless handset connect time belt powered down state to which only time Tpd.a1 to a cordless handset connect time belt notified with said beacon signal reduces a power consumption level of a cordless handset,
After said cordless handset connect time belt powered down state, it changes within said cordless handset connect time belt at a connection-request powered down state to which only predetermined time Tpd.a reduces a power consumption level of a cordless handset,
Broadcast transmission of the connection request signals which check that other radio is not performed after said connection-request powered down state, and require connection with said main phone including information on said cordless handset is carried out, A connection-request reply signal including connection permission information transmitted from said main phone to the connection request signals is received, and it changes from said non-connected state to said connected state.
A wireless-data-transmission start method characterized by things.
[Claim 7]
In a wireless-data-transmission start method according to claim 6,
When a connection-request reply signal over said connection request signals is not received,

only time Tpd.a2 until said beacon signal of the next by which broadcast transmission is carried out by said predetermined periodic Tb is received changes to said beacon powered down state.
A wireless-data-transmission start method characterized by things.
[Claim 8]
In a wireless-data-transmission start method according to claim 1 or 6,
Said cordless handset decides on the time Tda of said asynchronous powered down state at random within the limits of the predetermined minimum time Tdamin and the maximum time Tdamax predetermined whenever it changes to said asynchronous powered down state (Tdamax >Tdamin).
A wireless-data-transmission start method characterized by things.
[Claim 9]
In a wireless-data-transmission start method according to claim 4 or 6,
As for said cordless handset, time Tpd.a of said connection-request powered down state is determined at random within the limits of maximum time Tpd.amax (Tpd.amax >Tpd.amin) predetermined minimum time Tpd.amin and predetermined whenever it changes to said connection-request powered down state.
A wireless-data-transmission start method characterized by things.
[Claim 10]
In a wireless data communication device with which a cordless handset of a non-connected state which is not connected with a main phone establishes a radio link with a main phone, sets it as a connected state, and starts wireless data transmission before performing wireless data transmission between at least one cordless handset and a main phone connected to a predetermined network,
Said main phone is composition which transmits a time synchronized signal including time information which a communication timer generates once [at least] to the predetermined period time Tt,
Said cordless handset,
As said non-connected state, before receiving said time synchronized signal, have the asynchronous state which omits a time synchronization with said main phone, and in the asynchronous state. Said predetermined period time Tt A receive state for receiving said time synchronized signal to the above receiving time Tua (Tua>=Tt), When a time synchronized signal is repeatedly received by turns until said time synchronized signal is received in an asynchronous powered down state to which only the predetermined time Tda reduces a power consumption level of a cordless handset, when said time synchronized signal is not received in the meantime, A synchronous control means made into a synchronous state which amended a communication timer of a cordless handset based on the time information, and was synchronized with a main phone,
an unconnected power down control means which sets up only the predetermined time Tpd assigned for said every cordless handset after said synchronous state at an unconnected powered down state to which a power consumption level of a cordless handset is reduced,
Broadcast transmission of the connection request signals which require connection with said main phone after said unconnected powered down state including information on said cordless handset is carried out, A radio-link establishment means to receive a connection-request reply signal including connection permission information transmitted from said main phone to the connection request signals, to establish a radio link between said main phones, and to set it as said connected state
A wireless data communication device characterized by preparation ******.
[Claim 11]
In the wireless data communication device according to claim 10,
Said main phone is composition which carries out broadcast transmission of the beacon signal including information which shows a cordless handset connect time belt assigned for every cordless handset by predetermined periodic Tb controlled by said communication timer,
A beacon power down control means which sets only time Tpd.b until said beacon signal with which said cordless handset is obtained from time information of said time synchronized signal

instead of said unconnected power down control means arrives as a beacon powered down state to which a power consumption level of a cordless handset is reduced,
A beacon signal is received after said beacon powered down state, and it has a cordless handset connect time belt power down control means which sets only time Tpd.a1 to a cordless handset connect time belt notified with said beacon signal as a cordless handset connect time belt powered down state to which a power consumption level of a cordless handset is reduced,
Said radio-link establishment means is composition which carries out broadcast transmission of said connection request signals with a cordless handset connect time belt after said cordless handset connect time belt powered down state.
A wireless data communication device characterized by things.
[Claim 12]
In the wireless data communication device according to claim 11,
Said cordless handset connect time belt power down control means, When a beacon signal is not received after said beacon powered down state, it is the composition which only time Tpd.a2 until said beacon signal of the next by which broadcast transmission is carried out by said predetermined periodic Tb is received sets as said beacon powered down state.
A wireless data communication device characterized by things.
[Claim 13]
In the wireless data communication device according to claim 11,
Said cordless handset connect time belt power down control means includes a connection-request power down control means which sets only predetermined time Tpd.a as a connection-request powered down state to which a power consumption level of a cordless handset is reduced within said cordless handset connect time belt after said cordless handset connect time belt powered down state,
Said radio-link establishment means is composition which checks that other radio is not performed after said connection-request powered down state, and carries out broadcast transmission of said connection request signals.
A wireless data communication device characterized by things.
[Claim 14]
In the wireless data communication device according to claim 11 or 13,
Said radio-link establishment means is composition which only time Tpd.a2 until said beacon signal of the next by which broadcast transmission is carried out by said predetermined periodic Tb is received sets as said beacon powered down state, when a connection-request reply signal over said connection request signals is not received.
A wireless data communication device characterized by things.
[Claim 15]
With a wireless data communication system which performs wireless data transmission between at least one cordless handset and a main phone connected to a predetermined network. In a wireless data communication device which a cordless handset of a non-connected state which is not connected with a main phone establishes a radio link with a main phone, changes to a connected state, and starts wireless data transmission,
Said main phone is composition which carries out broadcast transmission of the beacon signal including time information which a communication timer generates, and information which shows a cordless handset connect time belt assigned for every cordless handset by predetermined periodic Tb controlled by said communication timer,
As said non-connected state, before said cordless handset receives said time synchronized signal, have it, and an asynchronous state which omits a time synchronization with said main phone in the asynchronous state. A receive state for receiving said beacon signal to said predetermined receiving time Tua, When said beacon signal is not received in the meantime, only the predetermined time Tda an asynchronous powered down state to which a power consumption level of a cordless handset is reduced, A synchronous control means made into a synchronous state which amended a communication timer of a cordless handset based on the time information, and was repeatedly synchronized with a main phone by turns when said beacon signal was received until said beacon signal is received,

A cordless handset connect time belt power down control means set as a cordless handset connect time belt powered down state to which only time Tpd.a1 to a cordless handset connect time belt notified with said beacon signal reduces a power consumption level of a cordless handset after said synchronous state,
A connection-request power down control means set as a connection-request powered down state to which only predetermined time Tpd.a reduces a power consumption level of a cordless handset within said cordless handset connect time belt after said cordless handset connect time belt powered down state,
Broadcast transmission of the connection request signals which check that other radio is not performed after said connection-request powered down state, and require connection with said main phone including information on said cordless handset is carried out, A radio-link establishment means to receive a connection-request reply signal including connection permission information transmitted from said main phone to the connection request signals, to establish a radio link between said main phones, and to set it as said connected state
A wireless data communication device characterized by preparation ******.
[Claim 16]
In the wireless data communication device according to claim 15,
Said radio-link establishment means is composition which only time Tpd.a2 until said beacon signal of the next by which broadcast transmission is carried out by said predetermined periodic Tb is received sets as said beacon powered down state, when a connection-request reply signal over said connection request signals is not received.
A wireless data communication device characterized by things.
[Claim 17]
In the wireless data communication device according to claim 10 or 15,
Said synchronous control means is the composition of deciding on the time Tda of said asynchronous powered down state at random within the limits of the predetermined minimum time Tdamin and the maximum time Tdamax predetermined whenever it changes to said asynchronous powered down state (Tdamax >Tdamin).
A wireless data communication device characterized by things.
[Claim 18]
In the wireless data communication device according to claim 13 or 15,
Whenever said connection-request power down control means changes to said connection-request powered down state, It is the composition of determining time Tpd.a of said connection-request powered down state at random within the limits of predetermined minimum time Tpd.amin and predetermined maximum time Tpd.amax (Tpd.amax >Tpd.amin).
A wireless data communication device characterized by things.
[Claim 19]
In the wireless data communication device according to any one of claims 10 to 15,
Said cordless handset is the composition of stopping the transmission and reception circuit and reducing power consumption, when a power down signal is outputted from said each power down control means including a transmission and reception circuit which transmits and receives a radio wave between said main phones.
A wireless data communication device characterized by things.

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
In the composition which performs wireless data transmission between cordless handsets, such as a Personal Digital Assistant in which this invention operates by a battery power supply, and main phones connected to wired networks, such as LAN, such as a wireless LAN base station, It is related with the wireless-data-transmission start method and wireless data communication device which aim at reduction of the power consumption of the cordless handset of a non-connected state which is not connected with a main phone.
[0002]
[Description of the Prior Art]
As for cordless handsets, such as a Personal Digital Assistant which operates by a battery power supply, when it is necessary to suppress consumption of a cell and it is not used, leaving to an energization condition is not preferred. However, when a power supply is turned OFF thoroughly in the case of the cordless handset supposing carrying out radio among main phones, such as a wireless LAN base station, the starting processing of utilization time will take a long time. Then, there is much what was constituted from such a cordless handset so that it could change between a suspend state with little power consumption and a normal operation state, in order to shorten warm-up time.
[0003]
For example, when a mobile station puts a power supply into the patent documents 1 first with the wireless data communication system of a statement, a mobile station is placed by the operating state until it receives a TIM message (traffic directions information) from a base station (access point). And according to a TIM message, it is chosen in an operating state and the hibernation in low electric power to the following TIM message. Thereby, the timing of the communication between a mobile station and a base station and the power OFF of a mobile station is determined, and low-electric-power-ization of the mobile station is enabled.
[0004]
[Patent documents 1]
JP,7-58688,A
[0005]
[Problem(s) to be Solved by the Invention]
However, with the wireless data communication system of a statement, to the patent documents 1. It is necessary to always operate the receiving circuit for narrow-band waves corresponding to a call signal etc. until it detects that the cordless handset of the non-connected state (at the time of standby) which is not connected with a main phone entered in the communication service area and connection with a main phone is completed. That is, although the cordless handset of the non-connected state was not communicating, electric power was consumed in the transmission and reception circuit, and consumption of the battery power supply was not avoided.
[0006]
An object of this invention is to provide the wireless-data-transmission start method and wireless data communication device which can aim at reduction of the power consumption of the cordless handset of a non-connected state which is not connected with a main phone.
[0007]
[Means for Solving the Problem]
(A wireless-data-transmission start method)
A wireless-data-transmission start method according to claim 1, A main phone transmits a time

synchronized signal including time information which a communication timer generates once [at least] to the predetermined period time Tt, and a cordless handset, As a non-connected state, before receiving a time synchronized signal, have the asynchronous state which omits a time synchronization with a main phone, and a cordless handset of an asynchronous state, Predetermined period time Tt A receive state for receiving a time synchronized signal to the above receiving time Tua (Tua>=Tt), When a time synchronized signal is repeatedly received by turns until a time synchronized signal is received in an asynchronous powered down state to which only the predetermined time Tda reduces a power consumption level of a cordless handset, when a time synchronized signal is not received in the meantime, It will be in a synchronous state which amended a communication timer of a cordless handset based on the time information, and was synchronized with a main phone, Only the predetermined time Tpd assigned for every cordless handset changes to an unconnected powered down state to which a power consumption level of a cordless handset is reduced, Broadcast transmission of the connection request signals which require connection with a main phone after an unconnected powered down state including information on a cordless handset is carried out, a connection-request reply signal including connection permission information transmitted from a main phone to the connection request signals is received, and it changes from a non-connected state to a connected state.

[0008]

A main phone a beacon signal including information which shows a cordless handset connect time belt assigned for every cordless handset, A cordless handset which carried out broadcast transmission by predetermined periodic Tb controlled by a communication timer, received a time synchronized signal from an asynchronous state of a non-connected state, and changed to a synchronous state, Only time Tpd.b until a beacon signal acquired from time information of a time synchronized signal arrives instead of changing to an unconnected powered down state, It changes to a beacon powered down state to which a power consumption level of a cordless handset is reduced, Receive a beacon signal after a beacon powered down state, and it changes to a cordless handset connect time belt powered down state to which only time Tpd.a1 to a cordless handset connect time belt notified with a beacon signal reduces a power consumption level of a cordless handset, Broadcast transmission of the connection request signals is carried out with a cordless handset connect time belt after a cordless handset connect time belt powered down state (claim 2).

[0009]

When a beacon signal is not received after a beacon powered down state, it may be made only for time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received to change to a beacon powered down state (claim 3).

[0010]

A cordless handset which went into a cordless handset connect time belt after a cordless handset connect time belt powered down state, Within a cordless handset connect time belt, it changes to a connection-request powered down state to which only predetermined time Tpd.a reduces a power consumption level of a cordless handset, It checks that other radio is not performed after a connection-request powered down state, and may be made to carry out broadcast transmission of the connection request signals (claim 4).

[0011]

When a connection-request reply signal over connection request signals is not received, it may be made only for time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received to change to a beacon powered down state (claim 5).

[0012]

A wireless-data-transmission start method according to claim 6 is the method of transmitting a time synchronized signal according to the above-mentioned beacon signal. A main phone namely, a beacon signal including time information which a communication timer generates, and information which shows a cordless handset connect time belt assigned for every cordless handset, By predetermined periodic Tb controlled by a communication timer, carry out broadcast

transmission and a cordless handset, As a non-connected state, before receiving a time synchronized signal, have the asynchronous state which omits a time synchronization with a main phone, and a cordless handset of an asynchronous state, A receive state for receiving a beacon signal to the predetermined receiving time Tua, When a beacon signal is repeatedly received by turns until a beacon signal is received in an asynchronous powered down state to which only the predetermined time Tda reduces a power consumption level of a cordless handset, when a beacon signal is not received in the meantime, It will be in a synchronous state which amended a communication timer of a cordless handset based on the time information, and was synchronized with a main phone, Only time Tpd.a1 to a cordless handset connect time belt notified with a beacon signal changes to a cordless handset connect time belt powered down state to which a power consumption level of a cordless handset is reduced, and after a cordless handset connect time belt powered down state within a cordless handset connect time belt, Only predetermined time Tpd.a changes to a connection-request powered down state to which a power consumption level of a cordless handset is reduced, and after a connection-request powered down state, Broadcast transmission of the connection request signals which check that other radio is not performed and require connection with a main phone including information on a cordless handset is carried out, A connection-request reply signal including connection permission information transmitted from a main phone to the connection request signals is received, and it changes from a non-connected state to a connected state.

[0013]

When a connection-request reply signal over connection request signals is not received, only time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received changes to a beacon powered down state (claim 7).

[0014]

In a wireless-data-transmission start method according to claim 1 or 6, a cordless handset, It decides on the time Tda of an asynchronous powered down state at random within the limits of the predetermined minimum time Tdamin and the maximum time Tdamax predetermined whenever it changes to an asynchronous powered down state (Tdamax >Tdamin) (claim 8).

[0015]

In a wireless-data-transmission start method according to claim 4 or 6, a cordless handset, Time Tpd.a of a connection-request powered down state is determined at random within the limits of maximum time Tpd.amax (Tpd.amax >Tpd.amin) predetermined minimum time Tpd.amin and predetermined whenever it changes to a connection-request powered down state (claim 9).

[0016]

(Wireless data communication device)

The wireless data communication device according to claim 10 is provided with the following.

A main phone is the predetermined period time Tt about a time synchronized signal including time information which a communication timer generates. Are the composition which transmits once [at least] and a cordless handset, As a non-connected state, before receiving a time synchronized signal, it has the asynchronous state which omits a time synchronization with a main phone, and it is the predetermined period time Tt in the asynchronous state. Receive state for receiving a time synchronized signal to the above receiving time Tua (Tua>=Tt)

When a time synchronized signal is repeatedly received by turns until a time synchronized signal is received in an asynchronous powered down state to which only the predetermined time Tda reduces a power consumption level of a cordless handset, when a time synchronized signal is not received in the meantime, A synchronous control means made into a synchronous state which amended a communication timer of a cordless handset based on the time information, and was synchronized with a main phone.

an unconnected power down control means which sets up only the predetermined time Tpd assigned for every cordless handset after a synchronous state at an unconnected powered down state to which a power consumption level of a cordless handset is reduced.

Broadcast transmission of the connection request signals which require connection with a main phone after an unconnected powered down state including information on a cordless handset is carried out, A radio-link establishment means to receive a connection-request reply signal

including connection permission information transmitted from a main phone to the connection request signals, to establish a radio link between main phones, and to set it as a connected state.

[0017]
A main phone a beacon signal including information which shows a cordless handset connect time belt assigned for every cordless handset, By predetermined periodic Tb controlled by a communication timer, are the composition which carries out broadcast transmission and a cordless handset, Only time Tpd.b until a beacon signal acquired from time information of a time synchronized signal arrives instead of an unconnected power down control means, A beacon power down control means set as a beacon powered down state to which a power consumption level of a cordless handset is reduced, Only time Tpd.a1 to a cordless handset connect time belt which receives a beacon signal after a beacon powered down state, and is notified with a beacon signal, Have a cordless handset connect time belt power down control means set as a cordless handset connect time belt powered down state to which a power consumption level of a cordless handset is reduced, and a radio-link establishment means, It is the composition which carries out broadcast transmission of the connection request signals with a cordless handset connect time belt after a cordless handset connect time belt powered down state (claim 11).
[0018]
A cordless handset connect time belt power down control means, When a beacon signal is not received after a beacon powered down state, it is the composition which only time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received sets as a beacon powered down state (claim 12).
[0019]
A cordless handset connect time belt power down control means, A connection-request power down control means which sets only predetermined time Tpd.a as a connection-request powered down state to which a power consumption level of a cordless handset is reduced within a cordless handset connect time belt after a cordless handset connect time belt powered down state is included, A radio-link establishment means is composition which checks that other radio is not performed after a connection-request powered down state, and carries out broadcast transmission of the connection request signals (claim 13).
[0020]
When a connection-request reply signal [as opposed to connection request signals in a radio-link establishment means] is not received, It is the composition which only time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received sets as a beacon powered down state (claim 14).
[0021]
The wireless data communication device according to claim 15 a main phone, Are the composition which carries out broadcast transmission of the beacon signal including time information which a communication timer generates, and information which shows a cordless handset connect time belt assigned for every cordless handset by predetermined periodic Tb controlled by a communication timer, and a cordless handset as a non-connected state, Before receiving a time synchronized signal, have the asynchronous state which omits a time synchronization with a main phone, and in the asynchronous state. A receive state for receiving a beacon signal to the predetermined receiving time Tua, When a beacon signal is repeatedly received by turns until a beacon signal is received in an asynchronous powered down state to which only the predetermined time Tda reduces a power consumption level of a cordless handset, when a beacon signal is not received in the meantime, A synchronous control means made into a synchronous state which amended a communication timer of a cordless handset based on the time information, and was synchronized with a main phone, A cordless handset connect time belt power down control means set as a cordless handset connect time belt powered down state to which only time Tpd.a1 to a cordless handset connect time belt notified with a beacon signal reduces a power consumption level of a cordless handset after a synchronous state, and after a cordless handset connect time belt powered down state, within a

cordless handset connect time belt, A connection-request power down control means set as a connection-request powered down state to which only predetermined time Tpd.a reduces a power consumption level of a cordless handset, Broadcast transmission of the connection request signals which check that other radio is not performed after a connection-request powered down state, and require connection with a main phone including information on a cordless handset is carried out, A connection-request reply signal including connection permission information transmitted from a main phone to the connection request signals is received, a radio link is established between main phones, and it has a radio-link establishment means to set it as a connected state.

[0022]

When a connection-request reply signal [as opposed to connection request signals in a radio-link establishment means] is not received, It is the composition which only time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received sets as a beacon powered down state (claim 16).

[0023]

In the wireless data communication device according to claim 10 or 15, a synchronous control means, It is the composition of deciding on the time Tda of an asynchronous powered down state at random within the limits of the predetermined minimum time Tdamin and the maximum time Tdamax predetermined whenever it changes to an asynchronous powered down state (Tdamax >Tdamin) (claim 17).

[0024]

In the wireless data communication device according to claim 13 or 15, a connection-request power down control means, It is the composition of determining time Tpd.a of a connection-request powered down state as predetermined minimum time Tpd.amin at random within the limits of maximum time Tpd.amax (Tpd.amax >Tpd.amin) predetermined whenever it changes to a connection-request powered down state (claim 18).

[0025]

In the wireless data-communication device according to any one of claims 10 to 15, a cordless handset, When a power down signal is outputted from each power down control means including a transmission and reception circuit which transmits and receives a radio wave between main phones, it is the composition of stopping the transmission and reception circuit and reducing power consumption (claim 19).

[0026]

[Embodiment of the Invention]

(The example of composition of the cordless handset of the wireless data communication device of this invention: Claims 10-19)

Drawing 1 shows the example of composition of the cordless handset of the wireless data communication device of this invention. The main phone which is not illustrated is composition which transmits a time synchronized signal including the time information which a communication timer generates once [at least] to the predetermined period time Tt, and before the cordless handset of a non-connected state receives a time synchronized signal, it is the asynchronous state which omits the time synchronization with a main phone. The main phone has transmitted the beacon signal which includes the information on the cordless handset connect time belt assigned for every cordless handset in order to make connection with each cordless handset by predetermined periodic Tb controlled by a communication timer, and the cordless handset can recognize now a cordless handset connect time belt by receiving a beacon signal. However, when a cordless handset is in a main phone and a synchronous state, it is also possible to judge autonomously the cordless handset connect time belt decided beforehand, for example by methods other than a beacon signal.

[0027]

In a figure, a cordless handset has the transmission and reception circuit 10 and the radio signal treating part 20, and the radio signal treating part 20 comprises the synchronous control means 21, the radio-link establishment means 22, and the power down control means 23.

[0028]

The transmission and reception circuit 10 receives with an antenna the radio wave transmitted from the main phone, changes it into a receiving radio signal, and is outputted to the radio signal treating part 20. The transmitting radio signal inputted from the radio signal treating part 20 is changed into a radio wave, and it transmits from an antenna. The transmission and reception circuit 10 is the composition of suspending the transmission and reception operations of a radio wave, and reducing power consumption, when a power down signal is inputted from the radio signal treating part 20.

[0029]

Among the receiving radio signals inputted from the transmission and reception circuit 10, the radio signal treating part 20 performs wireless data signal processing, and outputs the receiving wireless data signal from a main phone as a received data signal. The send data signal to a main phone performs wireless data signal processing, and outputs it to the transmission and reception circuit 10 as a transmitting radio signal. It outputs to the transmission and reception circuit 10 by making the transmitting radio control signal (for example, connection request signals) for controlling radio into a transmitting radio signal, Radio control signal processing is performed from the transmission and reception circuit 10 to the receiving radio control signal (for example, a time synchronized signal and a connection-request reply signal) for controlling radio among the inputted receiving radio signals.

[0030]

The synchronous control means 21 is the predetermined period time Tt. The receive state for receiving a time synchronized signal to the above receiving time Tua (Tua>=Tt), When a time synchronized signal is not received in the meantime, the asynchronous powered down state to which only the predetermined time Tda reduces the power consumption level of a cordless handset to the power down control means 23, When a time synchronized signal is repeatedly received by turns until a time synchronized signal is received, it is the composition made into the synchronous state which amended the communication timer of the cordless handset based on the time information, and was synchronized with the main phone.

[0031]

The predetermined time Tpd of even the cordless handset connect time belt to which the power down control means 23 was assigned for every cordless handset after the synchronous state, Or it is the composition set as the powered down state to which predetermined time Tpd.b until a beacon signal is received etc. output a power down signal to the transmission and reception circuit 10, and the power consumption level of a cordless handset is reduced. Although asynchronous power down control, unconnected power down control, beacon power down control, cordless handset connect time belt power down control, and connection-request power down control are performed as the power down control means 23, it explains in each embodiment shown below in detail.

[0032]

The radio-link establishment means 22 carries out broadcast transmission of the connection request signals which require connection with a main phone after a powered down state including the information on a cordless handset, It is the composition which receives a connection-request reply signal including the connection permission information transmitted from the main phone to the connection request signals, establishes a radio link between main phones, and is set as a connected state.

[0033]

The wireless-data-transmission start method of a cordless handset is explained, respectively about a 4th embodiment shown in a 3rd embodiment, drawing 12 - drawing 14 which are shown in a 2nd embodiment, drawing 9 - drawing 11 which are hereafter shown in a 1st embodiment, drawing 5 - drawing 8 which are shown in drawing 2 - drawing 4.

[0034]

(A 1st embodiment: Claims 1, 8, 10, and 17)

Drawing 2 is a flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 1st embodiment. Drawing 3 shows the change state of a 1st embodiment. Drawing 4 shows the radio-link establishment sequence between the cordless handset-main

phones of a 1st embodiment.
[0035]
In drawing 2, when a connected state value is 1, it is considered as a non-connected state at a connected state and the time of 0, and when a power down signal value is 1, a power down signal shall be outputted to the transmission and reception circuit 10.
[0036]
In drawing 2 and drawing 3, when operation is started, or when connection interrupt with a main phone is detected, a cordless handset, Reception of a time synchronized signal is started and it is the predetermined period time Tt. The timer which measures the above receiving time Tua (Tua>=Tt) is started (S1, S2, time synchronized signal receive state ST0). When a time synchronized signal is not received between this receiving time Tua, it changes to an asynchronous powered down state (S3, S4, S5, asynchronous powered down state ST1). The timer which measures the asynchronous power down time Tda generated at random in an asynchronous powered down state is started, The transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until the asynchronous power down time Tda is completed, and it returns to reception of a time synchronized signal after the end of the asynchronous power down time Tda (S5, S6, S7, S2, ST1, ST0).
[0037]
If a time synchronized signal is received during the above repetition, it will be in the synchronous state which amended the communication timer of the cordless handset based on the time information, and was synchronized with the main phone, and will change to an unconnected powered down state (S4, S8, unconnected powered down state ST2). In an unconnected powered down state, the timer which measures the predetermined unconnected power down time Tpd is started, and the power consumption of a cordless handset is reduced until the unconnected power down time Tpd is completed (S8, S9, S10, ST2). After the unconnected power down time Tpd is completed, broadcast transmission of the connection request signals which require connection with a main phone including the information on a cordless handset is carried out (S11, connection-request send-state ST3), If a connection-request reply signal including the connection permission information transmitted from the main phone to the connection request signals is received, it will change from a non-connected state to a connected state (S12, S13).
[0038]
In the radio-link establishment sequence shown in drawing 4, reception of a time synchronized signal goes wrong by the receiving time Tua of the first time synchronized signal receive state, and only the power down time Tda generated at random will be in an asynchronous powered down state, and will be in a time synchronized signal receive state after that. At this time, a time synchronized signal can be received within the receiving time Tua, it will be in the synchronous state which amended the communication timer of the cordless handset based on that time information, and was synchronized with the main phone, and only the predetermined power down time Tpd will be in an unconnected powered down state. Broadcast transmission of the connection request signals is carried out after that, a connection-request reply signal including the connection permission information transmitted from the main phone to the connection request signals is received, and a radio link is established.
[0039]
Whenever it changes to an asynchronous powered down state about the asynchronous power down time Tda, By setting up at random within the limits of the predetermined minimum time Tdamin and the predetermined maximum time Tdamax (Tdamax >Tdamin), probability of receiving a time synchronized signal can be made high, and the time to a communication start can be shortened.
[0040]
(A 2nd embodiment: Claims 2, 3, 5, 11, 12, and 14)
Drawing 5 and drawing 6 are flow charts which show the wireless-data-transmission access procedure (1) and (2) of the cordless handset of a 2nd embodiment. Drawing 7 shows the change state of a 2nd embodiment. Drawing 8 shows the radio-link establishment sequence between the

cordless handset-main phones of a 2nd embodiment. A main phone assumes that broadcast transmission of the beacon signal including the information which shows the cordless handset connect time belt assigned for every cordless handset is carried out by predetermined periodic Tb controlled by a communication timer.

[0041]

In drawing 5 and drawing 6, when a connected state value is 1, it is considered as a non-connected state at a connected state and the time of 0, and when a power down signal value is 1, a power down signal shall be outputted to the transmission and reception circuit 10.

[0042]

In drawing 5, drawing 6, and drawing 7, when operation is started, or when connection interrupt with a main phone is detected, a cordless handset, Reception of a time synchronized signal is started and it is the predetermined period time Tt. The timer which measures the above receiving time Tua (Tua>=Tt) is started (S1, S2, time synchronized signal receive state ST0). When a time synchronized signal is not received between this receiving time Tua, it changes to an asynchronous powered down state (S3, S4, S5, asynchronous powered down state ST1). The timer which measures the asynchronous power down time Tda generated at random in an asynchronous powered down state is started, The transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until the asynchronous power down time Tda is completed, and it returns to reception of a time synchronized signal after the end of the asynchronous power down time Tda (S5, S6, S7, S2, ST1, ST0).

[0043]

If a time synchronized signal is received during the above repetition, it will be in the synchronous state which amended the communication timer of the cordless handset based on the time information, and was synchronized with the main phone, and will change to a beacon powered down state (S4, S14, beacon powered down state ST4). In a beacon powered down state, the transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until it starts the timer which measures time Tpd.b until the beacon signal acquired from the time information of a time synchronized signal arrives and the time is completed. If a beacon signal is received after the end of beacon power down time Tpd.b (S15, S16, S21, beacon signal receive state ST5), it will change to a cordless handset connect time belt powered down state (S22, cordless handset connect time belt powered down state ST7).

[0044]

The timer which measures time Tpd.a1 to the cordless handset connect time belt notified with a beacon signal in a cordless handset connect time belt powered down state is started, The transmission and reception circuit of a cordless handset is stopped, power consumption is reduced until the time is completed, and the connection request signals which require connection with a main phone including the information on a cordless handset after that are transmitted (S23, S24, connection-request send-state ST8). And the timer which measures the response waiting time Taw of a connection-request reply signal is started (S24, connection-request response waiting state ST9). By the time the response waiting time Taw passes, when the connection-request reply signal from a main phone is received, The connection permission information included in a connection-request reply signal is checked, in the case of a connection permission, it is considered as a connected state (connected state value =1), and a radio link is established between main phones (S25, S26, S27, S28).

[0045]

The case (S21, ST5) where a beacon signal is unreceivable by the end of beacon power down time Tpd.b here, When the response waiting time Taw was completed, without receiving a connection-request reply signal (S26, ST9), or when connection with a main phone is disapproval (S27), it changes to a beacon powered down state (S29, beacon powered down state ST6). The timer which measures time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received in a beacon powered down state is started, The transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until beacon power down time Tpd.a2 is completed. After the end of beacon power down time Tpd.a2, it returns to a beacon signal receive state (S29, S30, S31,

S21, BST6, ST5). Beacon power down time Tpd.a2 is suitably calculated according to the process of each change state on the basis of beacon period Tb.
[0046]
In the radio-link establishment sequence shown in drawing 8, reception of a time synchronized signal goes wrong by the receiving time Tua of the first time synchronized signal receive state, and only the power down time Tda generated at random will be in an asynchronous powered down state, and will be in a time synchronized signal receive state after that. It will be in the synchronous state which could receive the time synchronized signal within the receiving time Tua, amended the communication timer of the cordless handset based on that time information at this time, and was synchronized with the main phone, Only time Tpd.b until the beacon signal acquired from the time information of a time synchronized signal arrives will be in a beacon powered down state, and receives a beacon signal after that.
[0047]
If a beacon signal is received, only time Tpd.a1 to the cordless handset connect time belt notified with a beacon signal will be in a cordless handset connect time belt powered down state, Connection request signals are transmitted after that, and if the connection-request reply signal from a main phone will be received by the time the response waiting time Taw passes, a radio link will be established between main phones.
[0048]
(A 3rd embodiment: Claims 4, 5, 9, 13, 14, and 18)
Drawing 9 is a flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 3rd embodiment. Drawing 10 shows the change state of a 3rd embodiment. Drawing 11 shows the radio-link establishment sequence between the cordless handset-main phones of a 3rd embodiment. A main phone assumes that broadcast transmission of the beacon signal including the information which shows the cordless handset connect time belt assigned for every cordless handset is carried out by predetermined periodic Tb controlled by a communication timer.
[0049]
In the wireless-data-transmission access procedure of the cordless handset of this embodiment, a cordless handset starts reception of a time synchronized signal, Wireless-data-transmission access procedure (1) of the cordless handset of a 2nd embodiment that shows drawing 5 a procedure until it will be in a beacon powered down state after receiving a time synchronized signal, and it receives a beacon signal It is the same.
[0050]
In drawing 9 and drawing 10, if a beacon signal is received (S21, beacon signal receive state ST5), it will change to a cordless handset connect time belt powered down state (S22, cordless handset connect time belt powered down state ST10). In a cordless handset connect time belt powered down state, the transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until it starts the timer which measures time Tpd.a1 to the cordless handset connect time belt notified with a beacon signal and the time is completed (S22, S23). The transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until it will be in a connection-request powered down state after that, it starts the timer which measures time Tpd.a until it starts carrier sensing and the time is completed (S41, S42).
[0051]
If time Tpd.a1 and Tpd.a pass since reception of a beacon signal, the timer which measures the carrier sense times Tcs will be started, and carrier sensing will be started (S43, S44, S45, carrier sensing state ST11). In not detecting other radio between these carrier sense times Tcs, The connection request signals which require connection with a main phone are transmitted (S44, S24, connection-request send-state ST8), and the timer which measures the response waiting time Taw of a connection-request reply signal is started (S24, connection-request response waiting state ST9). By the time the response waiting time Taw passes, when the connection-request reply signal from a main phone is received, The connection permission information included in a connection-request reply signal is checked, in the case of a connection permission,

it is considered as a connected state (connected state value =1), and a radio link is established between main phones (S25, S26, S27, S28).

[0052]

The case (S21, ST5) where a beacon signal is unreceivable by the end of beacon power down time Tpd.b here, The case (S45, ST11) where other radio signals are received in carrier sensing, When the response waiting time Taw was completed, without receiving a connection-request reply signal (S26, ST9), or when connection with a main phone is disapproval (S27), it changes to a beacon powered down state (S29, beacon powered down state ST6). The timer which measures time Tpd.a2 until the following beacon signal by which broadcast transmission is carried out by predetermined periodic Tb is received in a beacon powered down state is started, The transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until beacon power down time Tpd.a2 is completed. After the end of beacon power down time Tpd.a2, it returns to a beacon signal receive state (S29, S30, S31, S21, beacon powered down state ST6).

[0053]

It is the same as that of a 2nd embodiment shown in drawing 8 until it receives a beacon signal in the radio-link establishment sequence shown in drawing 11. If a beacon signal is received, only time Tpd.a until it starts time Tpd.a1 to a cordless handset connect time belt and carrier sensing which are notified with a beacon signal will be in a cordless handset connect time belt powered down state and a connection-request powered down state. Connection request signals are transmitted after that, and if the connection-request reply signal from a main phone will be received by the time the response waiting time Taw passes, a radio link will be established between main phones.

[0054]

Whenever it changes to a connection-request powered down state about time Tpd.a of a connection-request powered down state, By setting up at random within the limits of predetermined minimum time Tpd.amin and predetermined maximum time Tpd.amax (Tpd.amax >Tpd.amin), By chance, two or more cordless handsets can make low probability of carrying out carrier sensing simultaneously and failing, and can shorten the time to a communication start.

[0055]

(A 4th embodiment: Claims 6, 7, 9, 15, 16, and 18)

Drawing 12 is a flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 4th embodiment. Drawing 13 shows the change state of a 4th embodiment. Drawing 14 shows the radio-link establishment sequence between the cordless handset-main phones of a 4th embodiment. A main phone assumes that broadcast transmission of the beacon signal including the time information which a communication timer generates, and the information which shows the cordless handset connect time belt assigned for every cordless handset is carried out by predetermined periodic Tb controlled by a communication timer.

[0056]

The procedure after the wireless-data-transmission access procedure of the cordless handset of this embodiment transmitting a beacon signal and a time synchronized signal simultaneously and receiving a beacon signal is the same as that of the wireless-data-transmission access procedure of the cordless handset of a 3rd embodiment shown in drawing 9.

[0057]

In drawing 12 and drawing 13, when operation is started, or when connection interrupt with a main phone is detected, a cordless handset starts reception of a beacon signal and starts the timer which measures the predetermined receiving time Tua (S51, S52, beacon signal receive state ST13). When a beacon signal is not received between this receiving time Tua, it changes to an asynchronous powered down state (S53, S54, S55, asynchronous powered down state ST14). The timer which measures the power down time Tda generated at random in an asynchronous powered down state is started, The transmission and reception circuit of a cordless handset is stopped, and power consumption is reduced until the power down time Tda is completed, and it returns to reception of a beacon signal after the end of the power down time Tda (S54, S55, S56, S52, ST14, ST13).

[0058]
If a beacon signal is received during the above repetition, it will be in the synchronous state which amended the communication timer of the cordless handset based on the time information, and was synchronized with the main phone, Only time Tpd.a until it starts below time Tpd.a1 to a cordless handset connect time belt and carrier sensing which are notified with a beacon signal like a 3rd embodiment will be in a cordless handset connect time belt powered down state and a connection-request powered down state. Connection request signals are transmitted after that, and if the connection-request reply signal from a main phone will be received by the time the response waiting time Taw passes, a radio link will be established between main phones.
[0059]
In the radio-link establishment sequence shown in drawing 14, reception of a beacon signal goes wrong by the receiving time Tua of the first time synchronized signal receive state, and only the power down time Tda generated at random will be in an asynchronous powered down state, and will be in a beacon signal receive state after that. At this time, a beacon signal can be received within the receiving time Tua, and it will be in the synchronous state which amended the communication timer of the cordless handset based on that time information, and was synchronized with the main phone.
[0060]
And only time Tpd.a until it starts time Tpd.a1 to a cordless handset connect time belt and carrier sensing which are notified with a beacon signal will be in a cordless handset connect time belt powered down state and a connection-request powered down state. Connection request signals are transmitted after that, and if the connection-request reply signal from a main phone will be received by the time the response waiting time Taw passes, a radio link will be established between main phones.
[0061]
About the time Tda of an asynchronous powered down state, the beacon scanning interval of a cordless handset is determined, and in order to detect the beacon signal transmitted by beacon period Tb from the main phone, it sets up at random with values other than the integral multiple of beacon period Tb, or 1 for an integer. Thereby, a beacon signal can be received certainly and the time to a communication start can be shortened.
[0062]
[Effect of the Invention]
As explained above, by this invention, it does not always need to receive until it establishes a radio link, and the cordless handset of a non-connected state which is not connected to the main phone can provide a powered down state to suitable timing, and can stop the electric power supply to a transmission and reception circuit. Thereby, the power consumption in the cordless handset of a non-connected state can be reduced substantially.
[0063]
Especially by the invention of a statement, to claims 2, 3, 5, 6, and 7 and claims 11, 12, 14, 15, and 16. Since the hour entry in which the connection request of a cordless handset is possible is acquired by the beacon signal transmitted from a main phone, it can be set as a powered down state from after a time synchronization before transmission of connection request signals, and the electric power supply to a transmission and reception circuit can be stopped. Thereby, the power consumption in the cordless handset of a non-connected state can be reduced substantially.
[0064]
By the invention of a statement, to claims 4 and 5 and claims 13 and 14. By performing carrier sensing through connection-request power down time Tpd.a set up at random [when it goes into a cordless handset connect time belt], When two or more cordless handsets make low probability of carrying out carrier sensing simultaneously and failing and carry out carrier sensing further by chance, establishment which connection request signals collide with can be made low, and connection request signals can be transmitted efficiently.
[0065]
in an invention given in claims 6 and 7 and claims 15 and 16, since time information is always

transmitted as a beacon signal, be alike after a time synchronization — ** — transmission of carrier sensing and connection request signals can be performed at early time.
[0066]
By setting up the asynchronous power down time Tda at random, the probability of receiving a time synchronized signal becomes high, and claim 8 and the invention according to claim 17 can shorten the time to a time synchronization.
[0067]
Even if two or more cordless handsets carry out carrier sensing of claim 9 and the invention according to claim 18 simultaneously by chance by setting up connection-request power down time Tpd.a at random, the success probability of the following carrier sensing becomes high. Thereby, the probability that the connection request signals from two or more cordless handsets will collide is reduced, and the stable communication start is attained.
[Brief Description of the Drawings]
[Drawing 1]The figure showing the example of composition of the cordless handset of the wireless data communication device of this invention.
[Drawing 2]The flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 1st embodiment.
[Drawing 3]The figure showing the change state of a 1st embodiment.
[Drawing 4]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 1st embodiment.
[Drawing 5]Wireless-data-transmission access procedure (1) of the cordless handset of a 2nd embodiment Shown flow chart.
[Drawing 6]Wireless-data-transmission access procedure (2) of the cordless handset of a 2nd embodiment Shown flow chart.
[Drawing 7]The figure showing the change state of a 2nd embodiment.
[Drawing 8]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 2nd embodiment.
[Drawing 9]The flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 3rd embodiment.
[Drawing 10]The figure showing the change state of a 3rd embodiment.
[Drawing 11]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 3rd embodiment.
[Drawing 12]The flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 4th embodiment.
[Drawing 13]The figure showing the change state of a 4th embodiment.
[Drawing 14]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 4th embodiment.
[Description of Notations]
10 Transmission and reception circuit
20 Radio signal treating part
21 Synchronous control means
22 Radio-link establishment means
23 Power down control means

[Translation done.]

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

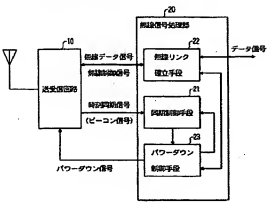
[Brief Description of the Drawings]
[Drawing 1]The figure showing the example of composition of the cordless handset of the wireless data communication device of this invention.
[Drawing 2]The flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 1st embodiment.
[Drawing 3]The figure showing the change state of a 1st embodiment.
[Drawing 4]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 1st embodiment.
[Drawing 5]Wireless-data-transmission access procedure (1) of the cordless handset of a 2nd embodiment Shown flow chart.
[Drawing 6]Wireless-data-transmission access procedure (2) of the cordless handset of a 2nd embodiment Shown flow chart.
[Drawing 7]The figure showing the change state of a 2nd embodiment.
[Drawing 8]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 2nd embodiment.
[Drawing 9]The flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 3rd embodiment.
[Drawing 10]The figure showing the change state of a 3rd embodiment.
[Drawing 11]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 3rd embodiment.
[Drawing 12]The flow chart which shows the wireless-data-transmission access procedure of the cordless handset of a 4th embodiment.
[Drawing 13]The figure showing the change state of a 4th embodiment.
[Drawing 14]The figure showing the radio-link establishment sequence between the cordless handset-main phones of a 4th embodiment.
[Description of Notations]
10 Transmission and reception circuit
20 Radio signal treating part
21 Synchronous control means
22 Radio-link establishment means
23 Power down control means

[Translation done.]

DRAWINGS

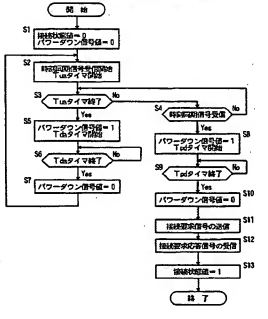
[Drawing 1]

本発明の無線データ通信装置の子機の構成例



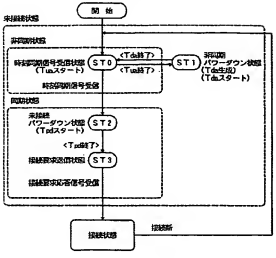
[Drawing 2]

第１の実施形態の子機の無線データ通信開始手順



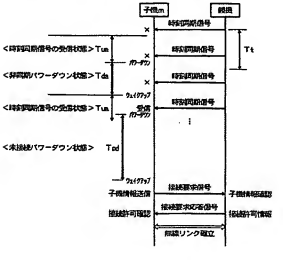
[Drawing 3]

第１の実施形態の状態遷移



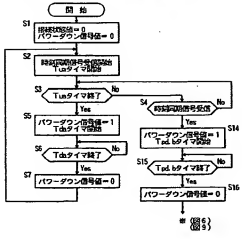
[Drawing 4]

第１の実施形態の子機－親機間の無線リンク確立シーケンス



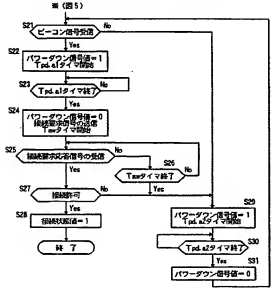
[Drawing 5]

第２の実施形態の子機の無線データ通信開始手順(1)



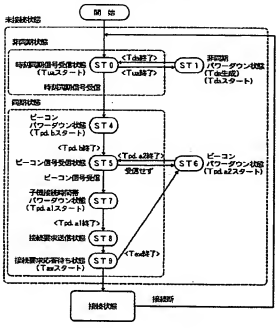
[Drawing 6]

第２の実施形態の子機の無線データ通信開始手順(2)



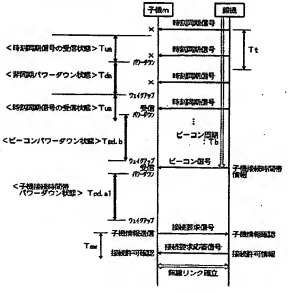
[Drawing 7]

第２の実施形態の状態遷移

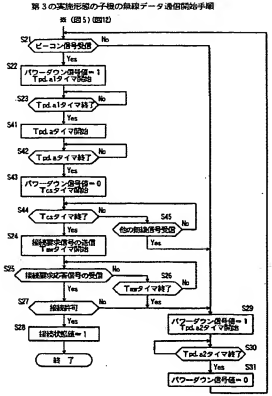


[Drawing 8]

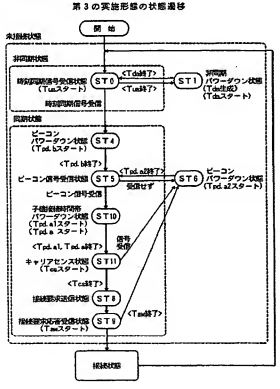
第２の実施形態の子機－親機間の無線リンク確立シーケンス



[Drawing 9]

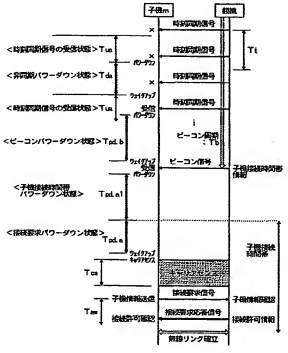


[Drawing 10]



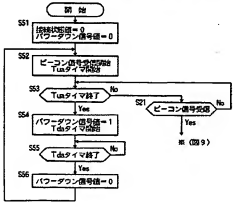
[Drawing 11]

第３の実施形態の子機－親機間の無線リンク確立シーケンス



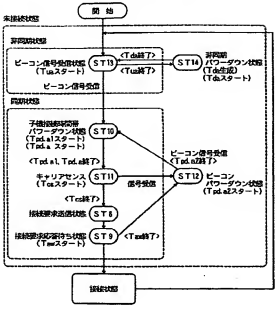
[Drawing 12]

第４の実施形態の子機の無線データ通信開始手順



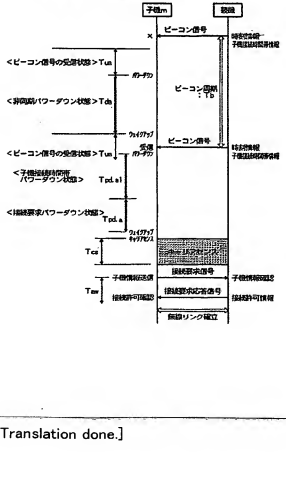
[Drawing 13]

第４の実施形態の状態遷移



[Drawing 14]

第４の実施形態の子機－親機間の無線リンク確立シーケンス



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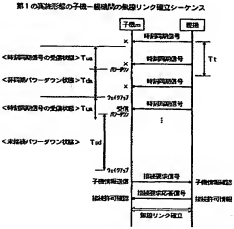
最終頁に続く

(54)【発明の名称】無線データ通信開始方法および無線データ通信装置

(57)【要約】
【課題】親機と接続されていない未接続状態の子機の消費電力の低減を図る。
【解決手段】親機は、通信タイマが生成する時刻情報を含む時刻同期信号を所定の周期時間Ｔｔ　に少なくとも１回送信し、非同期状態の子機は、時刻同期信号を受信するための受信状態と、その間に時刻同期信号が受信されない場合に所定の時間Ｔｄａだけ非同期パワーダウン状態とを、時刻同期信号が受信されるまで交互に繰り返し、時刻同期信号を受信したときにその時刻情報に基づいて親機に同期させた同期状態となり、子機ごとに割り当てられた所定の時間Ｔｐｄだけ未接続パワーダウン状態に遷移し、その後に、子機の情報を含み親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信して未接続状態から接続状態に遷移することを特徴とする。
【選択図】　図４



【特許請求の範囲】
【請求項1】
少なくとも１つの子機と、所定のネットワークに接続される親機との間で無線データ通信を行う無線データ通信システムで、親機と接続されていない未接続状態の子機が親機との無線リンクを確立して接続状態に遷移し、無線データ通信を開始する無線データ通信開始方法において、
前記親機は、通信タイマが生成する時刻情報を含む時刻同期信号を所定の周期時間Ｔｔに少なくとも１回送信し、
前記子機は、前記未接続状態として、前記時刻同期信号を受信する前で前記親機との時刻同期を行っていない非同期状態を有し、
前記非同期状態の子機は、
前記所定の周期時間Ｔｔ　以上の受信時間Ｔｕａ（Ｔｕａ≧Ｔｔ　）に前記時刻同期信号を受信するための受信状態と、その間に前記時刻同期信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、前記時刻同期信号が受信されるまで交互に繰り返し、
前記時刻同期信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、子機ごとに割り当てられた所定の時間Ｔｐｄだけ子機の電力消費レベルを低下させる未接続パワーダウン状態に遷移し、
前記未接続パワーダウン状態後に、前記子機の情報を含み前記親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して前記親機から送信された接続許可情報を含む接続要求応答信号を受信して前記未接続状態から前記接続状態に遷移する
ことを特徴とする無線データ通信開始方法。
【請求項2】
請求項１に記載の無線データ通信開始方法において、
前記親機は、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、前記通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信し、
前記未接続状態の前記非同期状態から前記時刻同期信号を受信して前記同期状態に遷移した子機は、前記未接続パワーダウン状態に遷移する代わりに、
前記時刻同期信号の時刻情報から得られる前記ビーコン信号が到着するまでの時間Ｔｐｄ．ｂだけ、子機の電力消費レベルを低下させるビーコンパワーダウン状態に遷移し、
前記ビーコンパワーダウン状態後にビーコン信号を受信し、前記ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　だけ子機の電力消費レベルを低下させる子機接続時間帯パワーダウン状態に遷移し、
前記子機接続時間帯パワーダウン状態後の子機接続時間帯で前記接続要求信号をブロードキャスト送信する
ことを特徴とする無線データ通信開始方法。
【請求項3】
請求項２に記載の無線データ通信開始方法において、
前記ビーコンパワーダウン状態後にビーコン信号が受信されないときは、前記所定の周期Ｔｂ　でブロードキャスト送信されている次の前記ビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけ前記ビーコンパワーダウン状態に遷移する
ことを特徴とする無線データ通信開始方法。
【請求項4】
請求項２に記載の無線データ通信開始方法において、
前記子機接続時間帯パワーダウン状態後に子機接続時間帯に入った子機は、
前記子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に遷移し、
前記接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して前記接続要求信号をブロードキャスト送信する

ことを特徴とする無線データ通信開始方法。
【請求項５】
請求項２または請求項４に記載の無線データ通信開始方法において、
前記接続要求信号に対する接続要求応答信号が受信されないときは、前記所定の周期Ｔｂでブロードキャスト送信されている次の前記ビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけ前記ビーコンパワーダウン状態に遷移する
ことを特徴とする無線データ通信開始方法。
【請求項６】
少なくとも１つの子機と、所定のネットワークに接続される親機との間で無線データ通信を行う無線データ通信システムで、親機と接続されていない未接続状態の子機が親機との無線リンクを確立して接続状態に遷移し、無線データ通信を開始する無線データ通信開始方法において、
前記親機は、通信タイマが生成する時刻情報と、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、前記通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信し、
前記子機は、前記未接続状態として、前記時刻同期信号を受信する前で前記親機との時刻同期を行っていない非同期状態を有し、
前記非同期状態の子機は、
前記所定の受信時間Ｔｕａに前記ビーコン信号を受信するための受信状態と、その間に前記ビーコン信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、前記ビーコン信号が受信されるまで交互に繰り返し、
前記ビーコン信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、前記ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａｌ　だけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に遷移し、
前記子機接続時間帯パワーダウン状態後に、前記子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に遷移し、
前記接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して前記子機の情報を含み前記親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して前記親機から送信された接続許可情報を含む接続要求応答信号を受信して前記未接続状態から前記接続状態に遷移する
ことを特徴とする無線データ通信開始方法。
【請求項７】
請求項６に記載の無線データ通信開始方法において、
前記接続要求信号に対する接続要求応答信号が受信されないときは、前記所定の周期Ｔｂでブロードキャスト送信されている次の前記ビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけ前記ビーコンパワーダウン状態に遷移する
ことを特徴とする無線データ通信開始方法。
【請求項８】
請求項１または請求項６に記載の無線データ通信開始方法において、
前記子機は、前記非同期パワーダウン状態に遷移する度に、所定の最小時間Ｔｄａｍｉｎと所定の最大時間Ｔｄａｍａｘ　（Ｔｄａｍａｘ　＞Ｔｄａｍｉｎ　）の範囲内でランダムに前記非同期パワーダウン状態の時間Ｔｄａを決定する
ことを特徴とする無線データ通信開始方法。
【請求項９】
請求項４または請求項６に記載の無線データ通信開始方法において、
前記子機は、前記接続要求パワーダウン状態に遷移する度に、所定の最小時間Ｔｐｄ．ａｍｉｎ　と所定の最大時間Ｔｐｄ．ａｍａｘ　（Ｔｐｄ．ａｍａｘ　＞Ｔｐｄ．ａｍｉｎ　）の範囲内でランダムに前記接続要求パワーダウン状態の時間Ｔｐｄ．ａを決定する

ことを特徴とする無線データ通信開始方法。
【請求項10】
少なくとも１つの子機と、所定のネットワークに接続される親機との間で無線データ通信を行う前に、親機と接続されていない未接続状態の子機が親機との無線リンクを確立して接続状態に設定し、無線データ通信を開始する無線データ通信装置において、
前記親機は、通信タイマが生成する時刻情報を含む時刻同期信号を所定の周期時間Ｔｔに少なくとも１回送信する構成であり、
前記子機は、
前記未接続状態として、前記時刻同期信号を受信する前で前記親機との時刻同期を行っていない非同期状態を有し、その非同期状態のときに、前記所定の周期時間Ｔｔ　以上の受信時間Ｔｕａ（Ｔｕａ≧Ｔｔ　）に前記時刻同期信号を受信するための受信状態と、その間に前記時刻同期信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、前記時刻同期信号が受信されるまで交互に繰り返し、時刻同期信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態とする同期制御手段と、
前記同期状態後に、前記子機ごとに割り当てられた所定の時間Ｔｐｄだけ子機の電力消費レベルを低下させる未接続パワーダウン状態に設定する未接続パワーダウン制御手段と、
前記未接続パワーダウン状態後に、前記子機の情報をのみ前記親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して前記親機から送信された接続許可情報を含む接続要求応答信号を受信して前記親機との間に無線リンクを確立し、前記接続状態に設定する無線リンク確立手段と
を備えたことを特徴とする無線データ通信装置。
【請求項11】
請求項１０に記載の無線データ通信装置において、
前記親機は、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、前記通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信する構成であり、
前記子機は、前記未接続パワーダウン制御手段に代わり、前記時刻同期信号の時刻情報から得られる前記ビーコン信号が到着するまでの時間Ｔｐｄ．ｂだけ、子機の電力消費レベルを低下させるビーコンパワーダウン状態に設定するビーコンパワーダウン制御手段と、
前記ビーコンパワーダウン状態後にビーコン信号を受信し、前記ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　だけ、子機の電力消費レベルを低下させる子機接続時間帯パワーダウン状態に設定する子機接続時間帯パワーダウン制御手段とを備え、
前記無線リンク確立手段は、前記子機接続時間帯パワーダウン状態後の子機接続時間帯で前記接続要求信号をブロードキャスト送信する構成である
ことを特徴とする無線データ通信装置。
【請求項12】
請求項１１に記載の無線データ通信装置において、
前記子機接続時間帯パワーダウン制御手段は、前記ビーコンパワーダウン状態後にビーコン信号が受信されないときに、前記所定の周期Ｔｂ　でブロードキャスト送信されている次の前記ビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけ前記ビーコンパワーダウン状態に設定する構成である
ことを特徴とする無線データ通信装置。
【請求項13】
請求項１１に記載の無線データ通信装置において、
前記子機接続時間帯パワーダウン制御手段は、前記子機接続時間帯パワーダウン状態後の前記子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に設定する接続要求パワーダウン制御手段を含み、
前記無線リンク確立手段は、前記接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して前記接続要求信号をブロードキャスト送信する構成である

ことを特徴とする無線データ通信装置。
【請求項14】
請求項１１または請求項１３に記載の無線データ通信装置において、
前記無線リンク確立手段は、前記接続要求信号に対する接続要求応答信号が受信されないときに、前記所定の周期Ｔｂ　でブロードキャスト送信されている次の前記ビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけ前記ビーコンパワーダウン状態に設定する構成である
ことを特徴とする無線データ通信装置。
【請求項15】
少なくとも１つの子機と、所定のネットワークに接続される親機との間で無線データ通信を行う無線データ通信システムで、親機と接続されていない未接続状態の子機が親機との無線リンクを確立して接続状態に遷移し、無線データ通信を開始する無線データ通信装置において、
前記親機は、通信タイマが生成する時刻情報と、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、前記通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信する構成であり、
前記子機は、前記未接続状態として、前記時刻同期信号を受信する前で前記親機との時刻同期を行っていない非同期状態を有し、その非同期状態のときに、前記所定の受信時間Ｔｕａに前記ビーコン信号を受信するための受信状態と、その間に前記ビーコン信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、前記ビーコン信号が受信されるまで交互に繰り返し、前記ビーコン信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態とする同期制御手段と、
前記同期状態後に、前記ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　だけ子機の電力消費レベルを低下させる子機接続時間帯パワーダウン状態に設定する子機接続時間帯パワーダウン制御手段と、
前記子機接続時間帯パワーダウン状態後に、前記子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に設定する接続要求パワーダウン制御手段と、
前記接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して前記子機の情報を含み前記親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して前記親機から送信された接続許可情報を含む接続要求応答信号を受信して前記親機との間に無線リンクを確立し、前記接続状態に設定する無線リンク確立手段と
を備えたことを特徴とする無線データ通信装置。
【請求項16】
請求項１５に記載の無線データ通信装置において、
前記無線リンク確立手段は、前記接続要求信号に対する接続要求応答信号が受信されないときは、前記所定の周期Ｔｂ　でブロードキャスト送信されている次の前記ビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけ前記ビーコンパワーダウン状態に設定する構成である
ことを特徴とする無線データ通信装置。
【請求項17】
請求項１０または請求項１５に記載の無線データ通信装置において、
前記同期制御手段は、前記非同期パワーダウン状態に遷移する度に、所定の最小時間Ｔｄａｍｉｎ　と所定の最大時間Ｔｄａｍａｘ　（Ｔｄａｍａｘ　＞Ｔｄａｍｉｎ　）の範囲内でランダムに前記非同期パワーダウン状態の時間Ｔｄａを決定する構成である
ことを特徴とする無線データ通信装置。
【請求項18】
請求項１３または請求項１５に記載の無線データ通信装置において、

前記接続要求パワーダウン制御手段は、前記接続要求パワーダウン状態に遷移する度に、所定の最小時間Ｔｐｄ．ａｍｉｎ と所定の最大時間Ｔｐｄ．ａｍａｘ （Ｔｐｄ．ａｍａｘ ＞Ｔｐｄ．ａｍｉｎ ）の範囲内でランダムに前記接続要求パワーダウン状態の時間Ｔｐｄ．ａを決定する構成である
ことを特徴とする無線データ通信装置。
【請求項19】
請求項１０～請求項１５のいずれかに記載の無線データ通信装置において、
前記子機は、前記親機との間で無線電波を送受信する送受信回路を含み、前記各パワーダウン制御手段からパワーダウン信号が出力されるとその送受信回路を停止して消費電力を低減する構成である
ことを特徴とする無線データ通信装置。

【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、電池電源で動作する携帯情報端末等の子機と、ＬＡＮなどの有線ネットワークに接続された無線ＬＡＮ基地局等の親機との間で無線データ通信を行う構成において、親機と接続されていない未接続状態の子機の消費電力の低減を図る無線データ通信開始方法および無線データ通信装置に関する。
【０００２】
【従来の技術】
電池電源で動作する携帯情報端末等の子機は電池の消耗を抑える必要があり、利用しないときに通電状態のままにしておくことは好ましくない。しかし、無線ＬＡＮ基地局等の親機との間で無線通信することを想定している子機の場合には、電源を完全にオフにすると、利用時の起動処理に長時間を要することになる。そこで、このような子機では、起動時間を短縮するために電力消費の少ないサスペンド状態と、通常動作状態との間で遷移できるように構成したものが多い。
【０００３】
例えば、特許文献１に記載の無線データ通信システムでは、移動局が最初に電源を入れた場合、移動局は基地局（アクセスポイント）からＴＩＭメッセージ（トラフィック指示情報）を受信するまで動作状態に置かれる。そして、ＴＩＭメッセージに応じて次のＴＩＭメッセージまで動作状態か、低電力での休止状態か選択される。これにより、移動局と基地局間の通信および移動局の電源オフのタイミングが決定され、移動局の低電力化を可能にしている。
【０００４】
【特許文献１】
特開平７－５８６８８号公報
【０００５】
【発明が解決しようとする課題】
しかし、特許文献１に記載の無線データ通信システムでは、親機と接続されていない未接続状態（待機時）の子機は、通信サービスエリア内に入ったことを検知して親機との接続が完了するまでは、呼出信号等に対応する狭帯域波用の受信回路は常時動作させておく必要がある。すなわち、未接続状態の子機は、通信を行っていないにも拘らず送受信回路で電力を消費し、電池電源の消耗が避けられなかった。
【０００６】
本発明は、親機と接続されていない未接続状態の子機の消費電力の低減を図ることができる無線データ通信開始方法および無線データ通信装置を提供することを目的とする。
【０００７】
【課題を解決するための手段】
（無線データ通信開始方法）
請求項１に記載の無線データ通信開始方法は、親機は、通信タイマが生成する時刻情報を

含む時刻同期信号を所定の周期時間Ｔｔ　に少なくとも１回送信し、子機は、未接続状態として、時刻同期信号を受信する前で親機との時刻同期を行っていない非同期状態を有し、非同期状態の子機は、所定の周期時間Ｔｔ　以上の受信時間Ｔｕａ（Ｔｕａ≧Ｔｔ　）に時刻同期信号を受信するための受信状態と、その間に時刻同期信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、時刻同期信号が受信されるまで交互に繰り返し、時刻同期信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、子機ごとに割り当てられた所定の時間Ｔｐｄだけ子機の電力消費レベルを低下させる未接続パワーダウン状態に遷移し、未接続パワーダウン状態後に、子機の情報を含み親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信して未接続状態から接続状態に遷移することを特徴とする。

【０００８】

さらに、親機は、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信し、未接続状態の非同期状態から時刻同期信号を受信して同期状態に遷移した子機は、未接続パワーダウン状態に遷移する代わりに、時刻同期信号の時刻情報から得られるビーコン信号が到着するまでの時間Ｔｐｄ．ｂだけ、子機の電力消費レベルを低下させるビーコンパワーダウン状態に遷移し、ビーコンパワーダウン状態後にビーコン信号を受信し、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　だけ子機の電力消費レベルを低下させる子機接続時間帯パワーダウン状態に遷移し、子機接続時間帯パワーダウン状態後の子機接続時間帯で接続要求信号をブロードキャスト送信する（請求項２）。

【０００９】

また、ビーコンパワーダウン状態後にビーコン信号が受信されないときは、所定の周期Ｔｂ　でブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけビーコンパワーダウン状態に遷移するようにしてもよい（請求項３）。

【００１０】

また、子機接続時間帯パワーダウン状態後に子機接続時間帯に入った子機は、子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に遷移し、接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して接続要求信号をブロードキャスト送信するようにしてもよい（請求項４）。

【００１１】

また、接続要求信号に対する接続要求応答信号が受信されないときは、所定の周期Ｔｂでブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけビーコンパワーダウン状態に遷移するようにしてもよい（請求項５）。

【００１２】

請求項６に記載の無線データ通信開始方法は、上記ビーコン信号に合わせて時刻同期信号を送信する方法である。すなわち、親機は、通信タイマが生成する時刻情報と、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信し、子機は、未接続状態として、時刻同期信号を受信する前で親機との時刻同期を行っていない非同期状態を有し、非同期状態の子機は、所定の受信時間Ｔｕａにビーコン信号を受信するための受信状態と、その間にビーコン信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、ビーコン信号が受信されるまで交互に繰り返し、ビーコン信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１だけ子機の電力消費レベルを低下させる子機接続時間帯パワーダウン状態に遷移し、子機接続時間帯パワーダウン状態後に、子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に遷移し、接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して子機の情報を含み親機への接

続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信して未接続状態から接続状態に遷移することを特徴とする。

【００１３】

さらに、接続要求信号に対する接続要求応答信号が受信されないときは、所定の周期Ｔｂでブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけビーコンパワーダウン状態に遷移する（請求項７）。

【００１４】

また、請求項１または請求項６に記載の無線データ通信開始方法において、子機は、非同期パワーダウン状態に遷移する度に、所定の最小時間Ｔｄａｍｉｎ　と所定の最大時間Ｔｄａｍａｘ　（Ｔｄａｍａｘ　＞Ｔｄａｍｉｎ　）の範囲内でランダムに非同期パワーダウン状態の時間Ｔｄａを決定する（請求項８）。

【００１５】

また、請求項４または請求項６に記載の無線データ通信開始方法において、子機は、接続要求パワーダウン状態に遷移する度に、所定の最小時間Ｔｐｄ．ａｍｉｎ　と所定の最大時間Ｔｐｄ．ａｍａｘ　（Ｔｐｄ．ａｍａｘ　＞Ｔｐｄ．ａｍｉｎ　）の範囲内でランダムに接続要求パワーダウン状態の時間Ｔｐｄ．ａを決定する（請求項９）。

【００１６】

（無線データ通信装置）

請求項１０に記載の無線データ通信装置は、親機は、通信タイマが生成する時刻情報を含む時刻同期信号を所定の周期時間Ｔｔ　に少なくとも１回送信する構成であり、子機は、未接続状態として、時刻同期信号を受信する前で親機との時刻同期を行っていない非同期状態を有し、その非同期状態のときに、所定の周期時間Ｔｔ　以上の受信時間Ｔｕａ（Ｔｕａ≧Ｔｔ　）に時刻同期信号を受信するための受信状態と、その間に時刻同期信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、時刻同期信号が受信されるまで交互に繰り返し、時刻同期信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態とする同期制御手段と、同期状態後に、子機ごとに割り当てられた所定の時間Ｔｐｄだけ子機の電力消費レベルを低下させる未接続パワーダウン状態に設定する未接続パワーダウン制御手段と、未接続パワーダウン状態後に、子機の情報を含み親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信して親機との間に無線リンクを確立し、接続状態に設定する無線リンク確立手段とを備える。

【００１７】

また、親機は、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信する構成であり、子機は、未接続パワーダウン制御手段に代わり、時刻同期信号の時刻情報から得られるビーコン信号が到着するまでの時間Ｔｐｄ．ｂだけ、子機の電力消費レベルを低下させるビーコンパワーダウン状態に設定するビーコンパワーダウン制御手段と、ビーコンパワーダウン状態後にビーコン信号を受信し、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　だけ、子機の電力消費レベルを低下させる子機接続時間帯パワーダウン状態に設定する子機接続時間帯パワーダウン制御手段とを備え、無線リンク確立手段は、子機接続時間帯パワーダウン状態後の子機接続時間帯で接続要求信号をブロードキャスト送信する構成である（請求項１１）。

【００１８】

また、子機接続時間帯パワーダウン制御手段は、ビーコンパワーダウン状態後にビーコン信号が受信されないときに、所定の周期Ｔｂ　でブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけビーコンパワーダウン状態に設定する構成である（請求項１２）。

【００１９】

また、子機接続時間帯パワーダウン制御手段は、子機接続時間帯パワーダウン状態後の子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に設定する接続要求パワーダウン制御手段を含み、無線リンク確立手段は、接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して接続要求信号をブロードキャスト送信する構成である（請求項１３）。

【００２０】

また、無線リンク確立手段は、接続要求信号に対する接続要求応答信号が受信されないときに、所定の周期Ｔｂ　でブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけビーコンパワーダウン状態に設定する構成である（請求項１４）。

【００２１】

請求項１５に記載の無線データ通信装置は、親機は、通信タイマが生成する時刻情報と、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信する構成であり、子機は、未接続状態として、時刻同期信号を受信する前で親機との時刻同期を行っていない非同期状態を有し、その非同期状態のときに、所定の受信時間Ｔｕａにビーコン信号を受信するための受信状態とし、その間にビーコン信号が受信されない場合に所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、ビーコン信号が受信されるまで交互に繰り返し、ビーコン信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態とする同期制御手段と、同期状態後に、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　だけ子機の電力消費レベルを低下させる子機接続時間帯パワーダウン状態に設定する子機接続時間帯パワーダウン制御手段と、子機接続時間帯パワーダウン状態後に、子機接続時間帯内で、所定の時間Ｔｐｄ．ａだけ子機の電力消費レベルを低下させる接続要求パワーダウン状態に設定する接続要求パワーダウン制御手段と、接続要求パワーダウン状態後に、他の無線通信が行われていないことを確認して子機の情報を含み親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信して親機との間に無線リンクを確立し、接続状態に設定する無線リンク確立手段とを備える。

【００２２】

さらに、無線リンク確立手段は、接続要求信号に対する接続要求応答信号が受信されないときは、所定の周期Ｔｂ　でブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　だけビーコンパワーダウン状態に設定する構成である（請求項１６）。

【００２３】

また、請求項１０または請求項１５に記載の無線データ通信装置において、同期制御手段は、非同期パワーダウン状態に遷移する度に、所定の最小時間Ｔｄａｍｉｎ　と所定の最大時間Ｔｄａｍａｘ　（Ｔｄａｍａｘ　＞Ｔｄａｍｉｎ　）の範囲内でランダムに非同期パワーダウン状態の時間Ｔｄａを決定する構成である（請求項１７）。

【００２４】

また、請求項１３または請求項１５に記載の無線データ通信装置において、接続要求パワーダウン制御手段は、接続要求パワーダウン状態に遷移する度に、所定の最小時間Ｔｐｄ．ａｍｉｎ　と所定の最大時間Ｔｐｄ．ａｍａｘ　（Ｔｐｄ．ａｍａｘ　＞Ｔｐｄ．ａｍｉｎ　）の範囲内でランダムに接続要求パワーダウン状態の時間Ｔｐｄ．ａを決定する構成である（請求項１８）。

【００２５】

また、請求項１０～請求項１５のいずれかに記載の無線データ通信装置において、子機は、親機との間で無線電波を送受信する送受信回路を含み、各パワーダウン制御手段からパワーダウン信号が出力されるとその送受信回路を停止して消費電力を低減する構成である（請求項１９）。

【００２６】
【発明の実施の形態】
（本発明の無線データ通信装置の子機の構成例：請求項１０～１９）
図１は、本発明の無線データ通信装置の子機の構成例を示す。なお、図示しない親機は、通信タイマが生成する時刻情報を含む時刻同期信号を所定の周期時間Ｔｔ　以上なくとも１回送信する構成であり、未接続状態の子機が時刻同期信号を受信する前は親機との時刻同期を行っていない非同期状態になっている。また、親機は、各子機との接続を行うために子機ごとに割り当てた子機接続時間帯の情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　で送信しており、子機は例えばビーコン信号を受信することにより子機接続時間帯を認識できるようになっている。ただし、子機が親機と同期状態になった場合には、ビーコン信号以外の方法によって、例えば予め決められた子機接続時間帯を自律的に判断することも可能である。
【００２７】
図において、子機は、送受信回路１０および無線信号処理部２０を有し、無線信号処理部２０は、同期制御手段２１、無線リンク確立手段２２およびパワーダウン制御手段２３から構成される。
【００２８】
送受信回路１０は、親機から送信された無線電波をアンテナで受信し、受信無線信号に変換して無線信号処理部２０に出力する。また、無線信号処理部２０から入力された送信無線信号を無線電波に変換してアンテナから送信する。さらに、送受信回路１０は、無線信号処理部２０からパワーダウン信号が入力されると、無線電波の送受信動作を停止して消費電力を低減する構成である。
【００２９】
無線信号処理部２０は、送受信回路１０から入力された受信無線信号のうち親機からの受信無線データ信号は、無線データ信号処理を施して受信データ信号として出力する。親機への送信データ信号は、無線データ信号処理を施して送信無線信号として送受信回路１０に出力する。また、無線通信を制御するための送信無線制御信号（例えば、接続要求信号）を送信無線信号として送受信回路１０に出力し、送受信回路１０から入力された受信無線信号のうち、無線通信を制御するための受信無線制御信号（例えば、時刻同期信号や接続要求応答信号）に対して無線制御信号処理を行う。
【００３０】
同期制御手段２１は、所定の周期時間Ｔｔ　以上の受信時間Ｔｕａ（Ｔｕａ≧Ｔｔ　）に時刻同期信号を受信するための受信状態と、その間に時刻同期信号が受信されない場合に、パワーダウン制御手段２３に対して所定の時間Ｔｄａだけ子機の電力消費レベルを低下させる非同期パワーダウン状態とを、時刻同期信号が受信されるまで交互に繰り返し、時刻同期信号を受信したときに、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態とする構成である。
【００３１】
パワーダウン制御手段２３は、同期状態後に、子機ごとに割り当てられた子機接続時間帯までの所定の時間Ｔｐｄ、あるいはビーコン信号が受信されるまでの所定の時間Ｔｐｄ．ｂなど、送受信回路１０に対してパワーダウン信号を出力し、子機の電力消費レベルを低下させるパワーダウン状態に設定する構成である。なお、パワーダウン制御手段２３としては、非同期パワーダウン制御、未接続パワーダウン制御、ビーコンパワーダウン制御、子機接続時間帯パワーダウン制御、接続要求パワーダウン制御を行うが、詳しくは以下に示す各実施形態において説明する。
【００３２】
無線リンク確立手段２２は、パワーダウン状態後に、子機の情報を含み親機への接続を要求する接続要求信号をブロードキャスト送信し、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信して親機との間に無線リンクを確立し、接続状態に設定する構成である。

【００３３】
以下、図２～図４に示す第１の実施形態、図５～図８に示す第２の実施形態、図９～図１１に示す第３の実施形態、図１２～図１４に示す第４の実施形態について、それぞれ子機の無線データ通信開始方法について説明する。
【００３４】
（第１の実施形態：請求項１，８，１０，１７）
図２は、第１の実施形態の子機の無線データ通信開始手順を示すフローチャートである。図３は、第１の実施形態の状態遷移を示す。図４は、第１の実施形態の子機－親機間の無線リンク確立シーケンスを示す。
【００３５】
図２において、接続状態値が１のときに接続状態、０のときに未接続状態とし、パワーダウン信号値が１のときに送受信回路１０にパワーダウン信号を出力するものとする。
【００３６】
図２および図３において、子機は、動作を開始したとき、または親機との接続断を検出したときに、時刻同期信号の受信を開始し、所定の周期時間Ｔｔ　以上の受信時間Ｔｕａ（Ｔｕａ≧Ｔｔ　）を計測するタイマをスタートさせる（Ｓ１，Ｓ２、時刻同期信号受信状態ＳＴ０）。この受信時間Ｔｕａの間に時刻同期信号が受信されない場合には、非同期パワーダウン状態に遷移する（Ｓ３，Ｓ４，Ｓ５、非同期パワーダウン状態ＳＴ１）。非同期パワーダウン状態では、ランダムに生成された非同期パワーダウン時間Ｔｄａを計測するタイマをスタートさせ、非同期パワーダウン時間Ｔｄａが終了するまで子機の送受信回路を停止して電力消費を低下させ、非同期パワーダウン時間Ｔｄａの終了後に時刻同期信号の受信に戻る（Ｓ５，Ｓ６，Ｓ７，Ｓ２、ＳＴ１，ＳＴ０）。
【００３７】
以上の繰り返し中に時刻同期信号を受信すると、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、未接続パワーダウン状態に遷移する（Ｓ４，Ｓ８，未接続パワーダウン状態ＳＴ２）。未接続パワーダウン状態では、所定の未接続パワーダウン時間Ｔｐｄを計測するタイマをスタートさせ、未接続パワーダウン時間Ｔｐｄが終了するまで子機の電力消費を低下させる（Ｓ８，Ｓ９，Ｓ１０、ＳＴ２）。未接続パワーダウン時間Ｔｐｄが終了すると、子機の情報を含み親機への接続を要求する接続要求信号をブロードキャスト送信し（Ｓ１１，接続要求送信状態ＳＴ３）、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信すると、未接続状態から接続状態に遷移する（Ｓ１２，Ｓ１３）。
【００３８】
図４に示す無線リンク確立シーケンスでは、最初の時刻同期信号受信状態の受信時間Ｔｕａで時刻同期信号の受信に失敗し、ランダムに生成されたパワーダウン時間Ｔｄａだけ非同期パワーダウン状態になり、その後に時刻同期信号受信状態になる。このときは、受信時間Ｔｕａ内で時刻同期信号を受信でき、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、所定のパワーダウン時間Ｔｐｄだけ未接続パワーダウン状態になる。その後に接続要求信号をブロードキャスト送信し、その接続要求信号に対して親機から送信された接続許可情報を含む接続要求応答信号を受信して無線リンクを確立する。
【００３９】
なお、非同期パワーダウン時間Ｔｄａについて、非同期パワーダウン状態に遷移する度に、所定の最小時間Ｔｄａｍｉｎ　と所定の最大時間Ｔｄａｍａｘ　（Ｔｄａｍａｘ　＞Ｔｄａｍｉｎ　）の範囲内でランダムに設定することにより、時刻同期信号を受信する確率を高くし、通信開始までの時間を短縮することができる。
【００４０】
（第２の実施形態：請求項２，３，５，１１，１２，１４）
図５および図６は、第２の実施形態の子機の無線データ通信開始手順（１），（２）　を示すフローチャートである。図７は、第２の実施形態の状態遷移を示す。図８は、第２の

実施形態の子機－親機間の無線リンク確立シーケンスを示す。なお、親機は、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信しているものとする。

【００４１】

図５および図６において、接続状態値が１のときに接続状態、０のときに未接続状態とし、パワーダウン信号値が１のときに送受信回路１０にパワーダウン信号を出力するものとする。

【００４２】

図５，図６および図７において、子機は、動作を開始したとき、または親機との接続断を検出したときに、時刻同期信号の受信を開始し、所定の周期時間Ｔｔ　以上の受信時間Ｔｕａ（Ｔｕａ≧Ｔｔ　）を計測するタイマをスタートさせる（Ｓ１，Ｓ２、時刻同期信号受信状態ＳＴ０）。この受信時間Ｔｕａの間に時刻同期信号が受信されない場合には、非同期パワーダウン状態に遷移する（Ｓ３，Ｓ４，Ｓ５、非同期パワーダウン状態ＳＴ１）。非同期パワーダウン状態では、ランダムに生成された非同期パワーダウン時間Ｔｄａを計測するタイマをスタートさせ、非同期パワーダウン時間Ｔｄａが終了するまで子機の送受信回路を停止して電力消費を低下させ、非同期パワーダウン時間Ｔｄａの終了後に時刻同期信号の受信に戻る（Ｓ５，Ｓ６，Ｓ７，Ｓ２、ＳＴ１，ＳＴ０）。

【００４３】

以上の繰り返し中に時刻同期信号を受信すると、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、ビーコンパワーダウン状態に遷移する（Ｓ４，Ｓ１４，ビーコンパワーダウン状態ＳＴ４）。ビーコンパワーダウン状態では、時刻同期信号の時刻情報から得られるビーコン信号が到着するまでの時間Ｔｐｄ．ｂを計測するタイマをスタートさせ、その時間が終了するまで子機の送受信回路を停止して電力消費を低下させる。ビーコンパワーダウン時間Ｔｐｄ．ｂの終了後にビーコン信号を受信すると（Ｓ１５，Ｓ１６，Ｓ２１、ビーコン信号受信状態ＳＴ５）、子機接続時間帯パワーダウン状態に遷移する（Ｓ２２、子機接続時間帯パワーダウン状態ＳＴ７）。

【００４４】

子機接続時間帯パワーダウン状態では、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　を計測するタイマをスタートさせ、その時間が終了するまで子機の送受信回路を停止して電力消費を低下させ、その後に子機の情報を含み親機への接続を要求する接続要求信号を送信する（Ｓ２３，Ｓ２４、接続要求送信状態ＳＴ８）。そして、接続要求応答信号の応答待ち時間Ｔａｗを計測するタイマをスタートさせる（Ｓ２４、接続要求応答待ち状態ＳＴ９）。応答待ち時間Ｔａｗが経過するまでに、親機からの接続要求応答信号が受信された場合には、接続要求応答信号に含まれる接続許可情報を確認し、接続許可の場合には接続状態（接続状態値＝１）とし、親機との間に無線リンクを確立する（Ｓ２５，Ｓ２６，Ｓ２７，Ｓ２８）。

【００４５】

ここで、ビーコンパワーダウン時間Ｔｐｄ．ｂの終了までにビーコン信号を受信できない場合（Ｓ２１、ＳＴ５）や、接続要求応答信号が受信されずに応答待ち時間Ｔａｗが終了した場合（Ｓ２６、ＳＴ９）や、親機への接続が不許可の場合（Ｓ２７）には、ビーコンパワーダウン状態に遷移する（Ｓ２９、ビーコンパワーダウン状態ＳＴ６）。ビーコンパワーダウン状態では、所定の周期Ｔｂ　でブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　を計測するタイマをスタートさせ、ビーコンパワーダウン時間Ｔｐｄ．ａ２　が終了するまで子機の送受信回路を停止して消費電力を低減させる。ビーコンパワーダウン時間Ｔｐｄ．ａ２　の終了後には、ビーコン信号受信状態に戻る（Ｓ２９，Ｓ３０，Ｓ３１，Ｓ２１、ビーＳＴ６，ＳＴ５）。なお、ビーコンパワーダウン時間Ｔｐｄ．ａ２　は、ビーコン周期Ｔｂ　を基準にそれぞれの状態遷移の過程に応じて適宜計算される。

【００４６】

図８に示す無線リンク確立シーケンスでは、最初の時刻同期信号受信状態の受信時間Ｔｕ

ａで時刻同期信号の受信に失敗し、ランダムに生成されたパワーダウン時間Ｔｄａだけ非同期パワーダウン状態になり、その後に時刻同期信号受信状態になる。このときは、受信時間Ｔｕａ内で時刻同期信号を受信でき、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、時刻同期信号の時刻情報から得られるビーコン信号が到着するまでの時間Ｔｐｄ．ｂだけビーコンパワーダウン状態になり、その後にビーコン信号を受信する。

【００４７】

ビーコン信号を受信すると、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　だけ子機接続時間帯パワーダウン状態になり、その後に接続要求信号を送信し、応答待ち時間Ｔａｗが経過するまでの間に親機からの接続要求応答信号が受信されると、親機との間に無線リンクを確立する。

【００４８】

（第３の実施形態：請求項４，５，９，１３，１４，１８）

図９は、第３の実施形態の子機の無線データ通信開始手順を示すフローチャートである。図１０は、第３の実施形態の状態遷移を示す。図１１は、第３の実施形態の子機－親機間の無線リンク確立シーケンスを示す。なお、親機は、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信しているものとする。

【００４９】

本実施形態の子機の無線データ通信開始手順において、子機が時刻同期信号の受信を開始し、時刻同期信号を受信後にビーコンパワーダウン状態となり、ビーコン信号を受信するまでの手順は、図５に示す第２の実施形態の子機の無線データ通信開始手順（１）　と同様である。

【００５０】

図９および図１０において、ビーコン信号を受信すると（Ｓ２１、ビーコン信号受信状態ＳＴ５）、子機接続時間帯パワーダウン状態に遷移する（Ｓ２２、子機接続時間帯パワーダウン状態ＳＴ１０）。子機接続時間帯パワーダウン状態では、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　を計測するタイマをスタートさせ、その時間が終了するまで子機の送受信回路を停止して電力消費を低下させる（Ｓ２２，Ｓ２３）。その後に接続要求パワーダウン状態になり、キャリアセンスを開始するまでの時間Ｔｐｄ．ａを計測するタイマをスタートさせ、その時間が終了するまで子機の送受信回路を停止して電力消費を低下させる（Ｓ４１，Ｓ４２）。

【００５１】

ビーコン信号の受信から時間Ｔｐｄ．ａ１　およびＴｐｄ．ａが経過すると、キャリアセンス時間Ｔｃｓを計測するタイマをスタートさせ、キャリアセンスを開始する（Ｓ４３，Ｓ４４，Ｓ４５、キャリアセンス状態ＳＴ１１）。このキャリアセンス時間Ｔｃｓの間に他の無線通信を検知しない場合には、親機への接続を要求する接続要求信号を送信し（Ｓ４４，Ｓ２４、接続要求送信状態ＳＴ８）、接続要求応答信号の応答待ち時間Ｔａｗを計測するタイマをスタートさせる（Ｓ２４、接続要求応答待ち状態ＳＴ９）。応答待ち時間Ｔａｗが経過するまでに、親機からの接続要求応答信号が受信された場合には、接続要求応答信号に含まれる接続許可情報を確認し、接続許可の場合には接続状態（接続状態値＝１）とし、親機との間に無線リンクを確立する（Ｓ２５，Ｓ２６，Ｓ２７，Ｓ２８）。

【００５２】

ここで、ビーコンパワーダウン時間Ｔｐｄ．ｂの終了までにビーコン信号を受信できない場合（Ｓ２１、ＳＴ５）や、キャリアセンス中に他の無線信号が受信された場合（Ｓ４５、ＳＴ１１）や、接続要求応答信号が受信されずに応答待ち時間Ｔａｗが終了した場合（Ｓ２６、ＳＴ９）や、親機への接続が不許可の場合（Ｓ２７）には、ビーコンパワーダウン状態に遷移する（Ｓ２９、ビーコンパワーダウン状態ＳＴ６）。ビーコンパワーダウン状態では、所定の周期Ｔｂ　でブロードキャスト送信されている次のビーコン信号が受信されるまでの時間Ｔｐｄ．ａ２　を計測するタイマをスタートさせ、ビーコンパワーダウ

ン時間Ｔｐｄ．ａ２　が終了するまで子機の送受信回路を停止して消費電力を低減させる。ビーコンパワーダウン時間Ｔｐｄ．ａ２　の終了後には、ビーコン信号受信状態に戻る（Ｓ２９，Ｓ３０，Ｓ３１，Ｓ２１、ビーコンパワーダウン状態ＳＴ６）。

【００５３】

図１１に示す無線リンク確立シーケンスでは、ビーコン信号を受信するまでは図８に示す第２の実施形態と同様である。ビーコン信号を受信すると、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　とキャリアセンスを開始するまでの時間Ｔｐｄ．ａだけ、子機接続時間帯パワーダウン状態および接続要求パワーダウン状態になる。その後に接続要求信号を送信し、応答待ち時間Ｔａｗが経過するまでの間に親機からの接続要求応答信号が受信されると、親機との間に無線リンクを確立する。

【００５４】

なお、接続要求パワーダウン状態の時間Ｔｐｄ．ａについて、接続要求パワーダウン状態に遷移する度に、所定の最小時間Ｔｐｄ．ａｍｉｎ　と所定の最大時間Ｔｐｄ．ａｍａｘ　（Ｔｐｄ．ａｍａｘ　＞Ｔｐｄ．ａｍｉｎ　）の範囲内でランダムに設定することにより、偶然に複数の子機が同時にキャリアセンスして失敗する確率を低くし、通信開始までの時間を短縮することができる。

【００５５】

（第４の実施形態：請求項６，７，９，１５，１６，１８）

図１２は、第４の実施形態の子機の無線データ通信開始手順を示すフローチャートである。図１３は、第４の実施形態の状態遷移を示す。図１４は、第４の実施形態の子機－親機間の無線リンク確立シーケンスを示す。なお、親機は、通信タイマが生成する時刻情報と、子機ごとに割り当てた子機接続時間帯を示す情報を含むビーコン信号を、通信タイマで制御される所定の周期Ｔｂ　でブロードキャスト送信しているものとする。

【００５６】

本実施形態の子機の無線データ通信開始手順は、ビーコン信号と時刻同期信号を同時に送信するものであり、ビーコン信号を受信した後の手順は、図９に示す第３の実施形態の子機の無線データ通信開始手順と同様である。

【００５７】

図１２および図１３において、子機は、動作を開始したとき、または親機との接続断を検出したときに、ビーコン信号の受信を開始し、所定の受信時間Ｔｕａを計測するタイマをスタートさせる（Ｓ５１，Ｓ５２、ビーコン信号受信状態ＳＴ１３）。この受信時間Ｔｕａの間にビーコン信号が受信されない場合には、非同期パワーダウン状態に遷移する（Ｓ５３，Ｓ５４，Ｓ５５、非同期パワーダウン状態ＳＴ１４）。非同期パワーダウン状態では、ランダムに生成されたパワーダウン時間Ｔｄａを計測するタイマをスタートさせ、パワーダウン時間Ｔｄａが終了するまで子機の送受信回路を停止して電力消費を低下させ、パワーダウン時間Ｔｄａの終了後にビーコン信号の受信に戻る（Ｓ５４，Ｓ５５，Ｓ５６，Ｓ５２、ＳＴ１４，ＳＴ１３）。

【００５８】

以上の繰り返し中にビーコン信号を受信すると、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となり、以下第３の実施形態と同様に、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　とキャリアセンスを開始するまでの時間Ｔｐｄ．ａだけ、子機接続時間帯パワーダウン状態および接続要求パワーダウン状態になる。その後に接続要求信号を送信し、応答待ち時間Ｔａｗが経過するまでの間に親機からの接続要求応答信号が受信されると、親機との間に無線リンクを確立する。

【００５９】

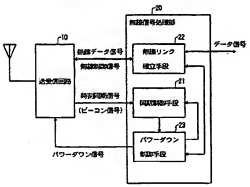
図１４に示す無線リンク確立シーケンスでは、最初の時刻同期信号受信状態の受信時間Ｔｕａでビーコン信号の受信に失敗し、ランダムに生成されたパワーダウン時間Ｔｄａだけ非同期パワーダウン状態になり、その後にビーコン信号受信状態になる。このときは、受信時間Ｔｕａ内でビーコン信号を受信でき、その時刻情報に基づいて子機の通信タイマを補正して親機に同期させた同期状態となる。

【００６０】
そして、ビーコン信号で通知される子機接続時間帯までの時間Ｔｐｄ．ａ１　とキャリアセンスを開始するまでの時間Ｔｐｄ．ａだけ、子機接続時間帯パワーダウン状態および接続要求パワーダウン状態になる。その後に接続要求信号を送信し、応答待ち時間Ｔａｗが経過するまでの間に親機からの接続要求応答信号が受信されると、親機との間に無線リンクを確立する。
【００６１】
なお、非同期パワーダウン状態の時間Ｔｄａについては、子機のビーコンスキャン周期を決定するものであり、親機からビーコン周期Ｔｂ　で送信されているビーコン信号を検知するために、ビーコン周期Ｔｂ　の整数倍、または整数分の１以外の値でランダムに設定する。これにより、ビーコン信号を確実に受信することができ、通信開始までの時間を短縮することができる。
【００６２】
【発明の効果】
以上説明したように、本発明により、親機に接続されていない未接続状態の子機は、無線リンクを確立するまで常時受信している必要がなく、適当なタイミングでパワーダウン状態を設け、送受信回路への電力供給を停止することができる。これにより、未接続状態の子機における消費電力を大幅に低減することができる。
【００６３】
特に、請求項２，３，５，６，７および請求項１１，１２，１４，１５，１６に記載の発明では、子機の接続要求可能な時間情報が親機から送信されるビーコン信号により得られるので、時刻同期後から接続要求信号の送信までの間にパワーダウン状態に設定し、送受信回路への電力供給を停止することができる。これにより、未接続状態の子機における消費電力を大幅に低減することができる。
【００６４】
また、請求項４，５および請求項１３，１４に記載の発明では、子機接続時間帯に入ったときにランダムに設定される接続要求パワーダウン時間Ｔｐｄ．ａを経てキャリアセンスを行うことにより、偶然に複数の子機が同時にキャリアセンスして失敗する確率を低くし、さらにキャリアセンスすることにより接続要求信号がぶつかる確立を低くし、効率的に接続要求信号を送信することができる。
【００６５】
また、請求項６，７および請求項１５，１６に記載の発明では、時刻情報は常にビーコン信号として送信されるので、時刻同期後によや早い時間にキャリアセンスおよび接続要求信号の送信を行うことができる。
【００６６】
また、請求項８および請求項１７に記載の発明は、非同期パワーダウン時間Ｔｄａをランダムに設定することにより、時刻同期信号を受信する確率が高くなり、時刻同期までの時間を短縮することができる。
【００６７】
また、請求項９および請求項１８に記載の発明は、接続要求パワーダウン時間Ｔｐｄ．ａをランダムに設定することにより、偶然に複数の子機が同時にキャリアセンスしても、次のキャリアセンスの成功確率が高くなる。これにより、複数の子機からの接続要求信号が衝突する確率を低減し、安定した通信開始が可能となる。
【図面の簡単な説明】
【図１】本発明の無線データ通信装置の子機の構成例を示す図。
【図２】第１の実施形態の子機の無線データ通信開始手順を示すフローチャート。
【図３】第１の実施形態の状態遷移を示す図。
【図４】第１の実施形態の子機－親機間の無線リンク確立シーケンスを示す図。
【図５】第２の実施形態の子機の無線データ通信開始手順（１）　を示すフローチャート

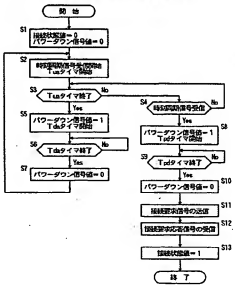
【図６】第２の実施形態の子機の無線データ通信開始手順（２）　を示すフローチャート

【図７】第２の実施形態の状態遷移を示す図。
【図８】第２の実施形態の子機－親機間の無線リンク確立シーケンスを示す図。
【図９】第３の実施形態の子機の無線データ通信開始手順を示すフローチャート。
【図１０】第３の実施形態の状態遷移を示す図。
【図１１】第３の実施形態の子機－親機間の無線リンク確立シーケンスを示す図。
【図１２】第４の実施形態の子機の無線データ通信開始手順を示すフローチャート。
【図１３】第４の実施形態の状態遷移を示す図。
【図１４】第４の実施形態の子機－親機間の無線リンク確立シーケンスを示す図。
【符号の説明】
１０　送受信回路
２０　無線信号処理部
２１　同期制御手段
２２　無線リンク確立手段
２３　パワーダウン制御手段

【図1】

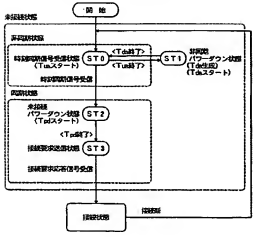


【図2】



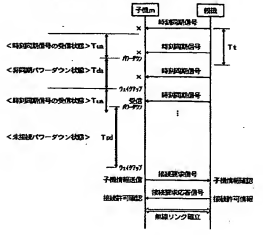
【図３】

第１の実施形態の状態遷移



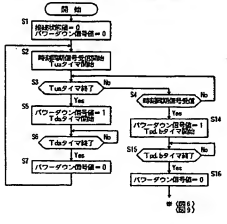
【図４】

第１の実施形態の子機－親機間の無線リンク確立シーケンス



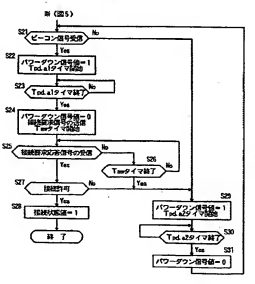
【図５】

第２の実施形態の子機の無線データ通信開始手順(1)



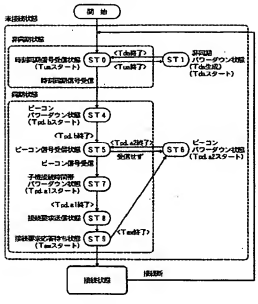
【図６】

第２の実施形態の子機の無線データ通信開始手順(2)



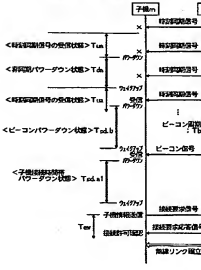
【図7】

第２の実施形態の状態遷移



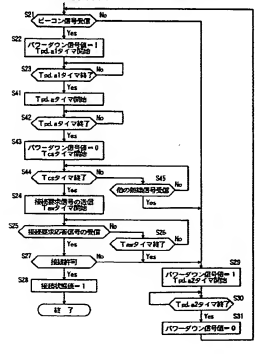
【図8】

第２の実施形態の子機－親機間の無線リンク確立シーケンス



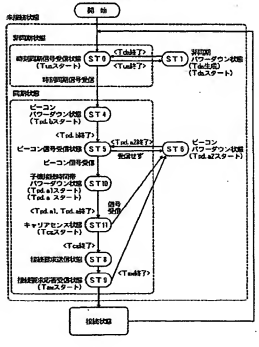
【図9】

第３の実施形態の子機の無線データ通信開始手順



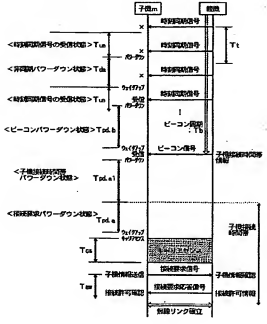
【図10】

第３の実施形態の状態遷移



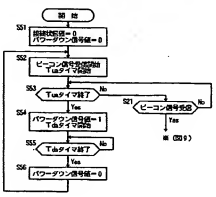
【図11】

第３の実施形態の子機ｍ－親機間の同期リンク確立シーケンス



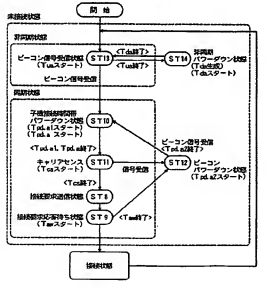
【図12】

第４の実施形態の子機の同期データ通信開始手順



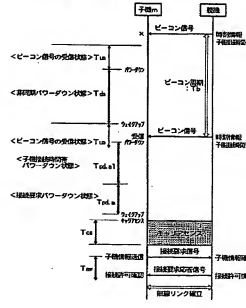
【図13】

第４の実施形態の状態遷移



【図14】

第４の実施形態の子機ｍ－親機間の同期リンク確立シーケンス



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